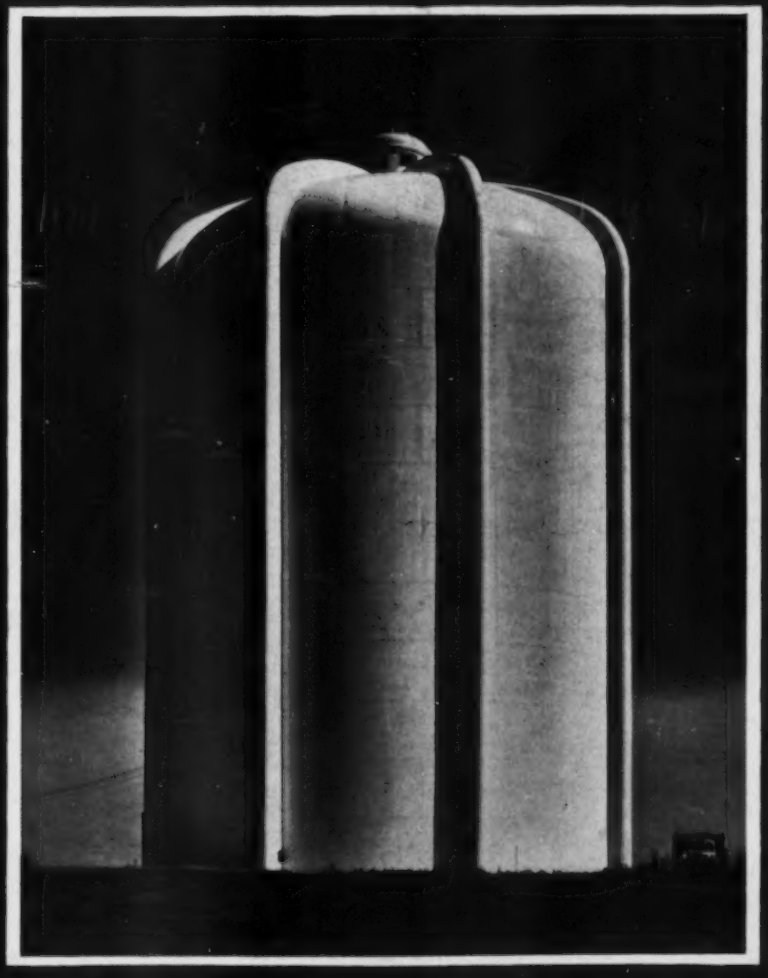
WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL



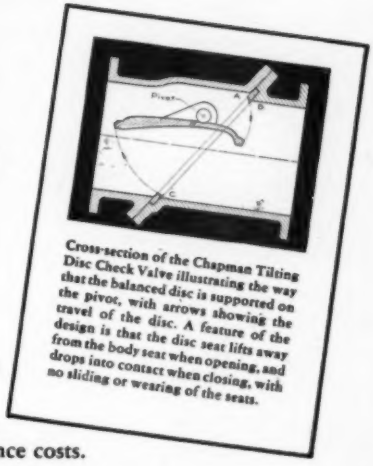
SEPTEMBER, 1951

CHAPMAN

TILTING DISC CHECK VALVES

Cut Maintenance Costs

with Cushioned-Closing



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

There's less wear on seating surfaces, hinge pins and bearings with the cushioned closing action in a Chapman Tilting Disc Check Valve. No destructive slamming. No fatiguing flutter. No vibration of pipe lines or adjacent structure — nor danger of opening pipe joints or rupturing pipe lines. Just a quick and quiet closure that cuts maintenance costs.

And what's more, the balanced streamlined discs in Chapman Tilting Disc Check Valves ride smoothly on the stream—reduce head losses 65 to 80% over conventional swing type checks. You'll want to know more about this maintenance-saving, more efficient check valve. Write today for engineering data, Bulletin #30.

THE CHAPMAN VALVE MANUFACTURING COMPANY

INDIAN ORCHARD, MASSACHUSETTS

COLD FACTS ON A HOT SUBJECT

METER MANUFACTURER USES EVERY MODERN TECHNIQUE TO POUR FINEST BRONZE CASTINGS

Pouring small meter bodies in the Rockwell foundry

The quality built into every Rockwell water meter is quickly apparent by examining the outside case. You won't find any pin holes, flaws or burnished areas on the smoothly grained surface of a Rockwell casting. That's because these castings are poured in Rockwell's own modern, completely mechanized foundry under close laboratory control.

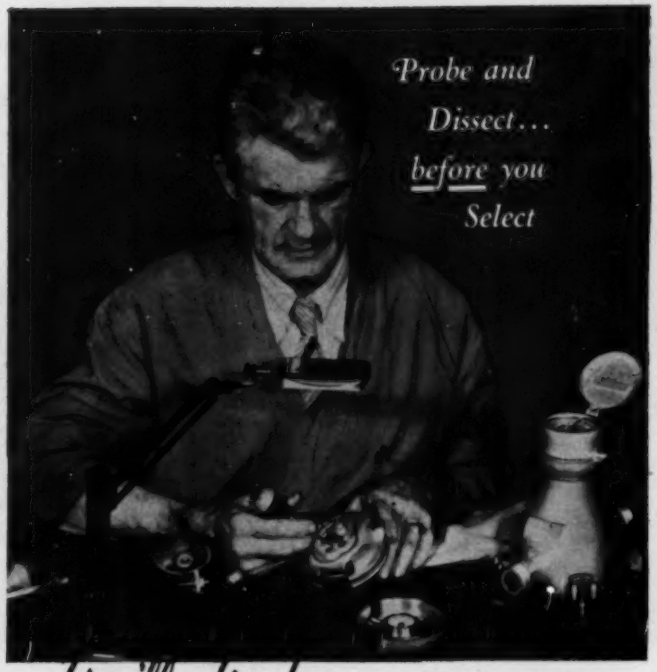
Real Alloy Bronze

Rockwell meter castings are made of real alloy bronze. No skimping on materials is permitted. Every casting must be made to the full 85-5-5-5 composition that is recommended for use in most meters. This material is made up of 85 per cent copper, 5 per cent tin, 5 per cent zinc and 5 per cent lead. But it takes more than fine materials to make a fine casting. It takes excellent foundry equipment, close laboratory supervision and foundry "know how" —all of which Rockwell has to a marked degree.

Green sand molds are made in multiples on a precision molding machine—cores are produced in a core blowing machine, then baked in a large temperature controlled gas fired oven. Crucible type melting furnaces reduce the metal. Every precaution is taken to make sure it is kept free from impurities. Finally the molten bronze is poured into the completed molds at prescribed temperatures that are carefully controlled by instruments.

Comparison Proves

You can actually see and feel the difference in Rockwell meter castings. And this superiority carries all the way through the meter manufacturing process, right down to the final testing. Full size, full weight, full copper content meter castings are just an exterior indication of the better values built into all Rockwell water meters.

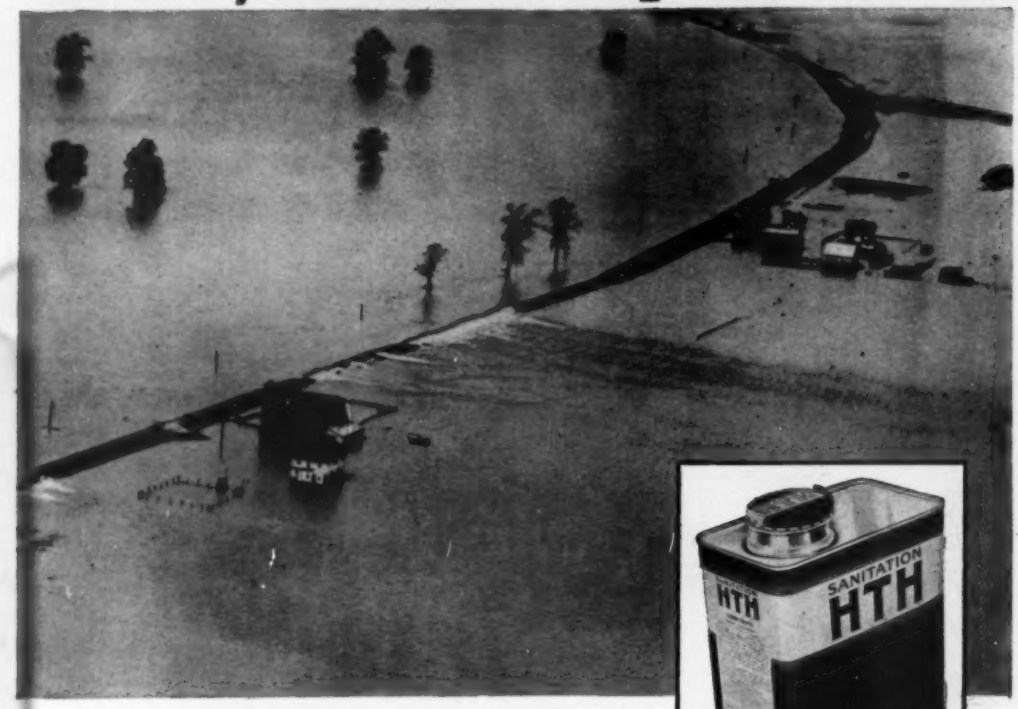


You'll find EVERY WANTED FEATURE IN EMPIRE METERS

What do you want of a meter... long life . . . repair ease and economy . . . sustained accuracy? Whatever your wants, we have wrapped them up for you in the Rockwell-Empire. Just examine this design. First you'll notice the Empire oscillating piston, performance proved in service since 1884 to provide maximum accuracy in measurement with minimum wear. Next you'll find the convenient arrangement of internal parts. Everything goes together like hand in glove. It was designed to save you money in maintenance. Consider too, the balance of this assembly with everything working in planes or perpendiculars. This construction offers less friction and provides more sensitivity to low flows and a longer meter life.

Now is the time to investigate metering the Empire way. Learn how to get *lasting accuracy* for the *longest life* at *lowest cost*. Ask your Rockwell representative for an eye-opening demonstration.

water, water everywhere...



Sanitation HTH is available in cases of nine handy 5-lb. cans and in 100-lb. drums.

but *None* that's fit to drink

That's what can happen when flash floods overtax your water purification system. But not if you have on hand a substantial stock of Sanitation HTH, the recognized dry chlorine source for emergency stand-by service.

Less dramatic but equally effective is the part Sanitation HTH can play in your everyday chlorination operations. Disinfecting of mains, tanks, basins, filters and reservoirs is made easy... your regular water chlorination program is made more effective.

Anywhere that chlorine action is needed, you can rely on HTH to do the job—and do it well! So don't wait for emergencies before you call on this versatile, free-flowing, stable chlorine source.

Write today for your own copy of "Hypo-Chlorination of Water" and learn about the many uses of Sanitation HTH. Mathieson Chemical Corporation, Mathieson Building, Baltimore 3, Maryland.

Mathieson
CHEMICALS

SERVING INDUSTRY, AGRICULTURE AND PUBLIC HEALTH

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WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

COMING ARTICLES

"How Du Pont Solved a Pollution Problem" is the story of measures applied at Waynesboro, Va., by Dr. Roy McCracken. . . . "Basic Factors in Centrifugal Pump Application" will be further discussed by Messrs. Carter and Karassik in their series of articles. . . . "Water Treating Experiences" presented in a series by A. H. Ullrich is being amplified in a closing installment. . . . "Sewer Maintenance in Savannah" by H. W. Jenkins, Supt., tells how Savannah, Ga., has stepped up its maintenance job with the latest improved equipment. . . . "Elevated Tank and Standpipe Disinfection" by a simplified practical method is being described by H. W. Tracy and H. P. Nilmeier of San Francisco. . . . "Computing the Size of Revenue Bond Issues" for public water supply, is discussed by Geo. D. Russell. . . .

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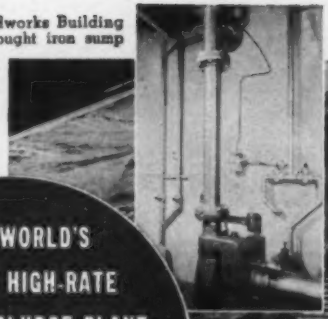
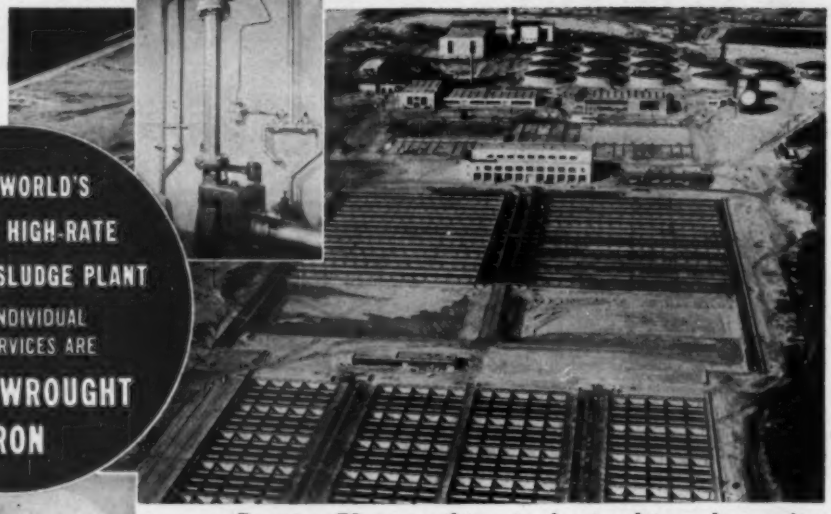
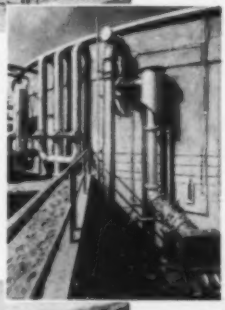


Pump room in Headworks Building showing genuine wrought iron sump pump and grit pump discharge pipe, and effluent wash water lines.



In the WORLD'S LARGEST HIGH-RATE ACTIVATED SLUDGE PLANT 51 INDIVIDUAL SERVICES ARE BYERS WROUGHT IRON

Showing genuine wrought iron water, gas and air lines leading into gas purifier.



Showing genuine wrought iron vents, water, effluent, and gas manometer lines on one of the 18 digester tanks.

Showing genuine wrought iron weir plates in final settling tanks at sludge plant.

Covering 76 acres, this $41,000,000.00 Hyperion sewage treatment plant of the City of Los Angeles is the world's largest treatment works using high-rate activated sludge process combined with sludge digestion, power generation, and fertilizer production.

In the design and work planning, engineers under Lloyd Aldrich, City Engineer, took decisive steps to forestall excessive maintenance and premature failure by specifying genuine wrought iron for 51 individual services where corrosion is a threat to durability. In the Primary Settling System, Digestion System, Power and Boiler Plant, Aeration System, General Piping System, Final Settling System, Elutriation System, and Ocean Outfall Sewer, genuine wrought iron safeguards a wide range of services against corrosion hazards. More than 141 tons of Byers Wrought Iron was used in fresh water lines, sump pump discharge lines, weir plates, condensate piping, instrument air piping, down spouts, flushing lines, air lines, underground piping, bearing plates, and many other services too numerous to list. Metcalf & Eddy of Boston were Consulting Sanitary Engineers; Merrill Butler, Deputy Engineer in charge of design; E. G. Studley, Engineer of Sewer Design; C. L. Bell, Projects Coordinating Engineer; G. A. Parkes, Senior Treatment Plant Design Engineer; and F. M. Darnell, Senior Administrative Engineer. The plant is being operated by the Bureau of Engineering.

The unique structure and composition of Byers Wrought Iron provides the needed service qualities for these punishing applications. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and "detour" corrosive attack. They also help anchor the initial protective scale, which shields the underlying metal.

Our bulletin, WROUGHT IRON FOR SEWAGE TREATMENT AND DISPOSAL INSTALLATIONS, gives some helpful information on how to reduce repairs and maintenance. Write for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

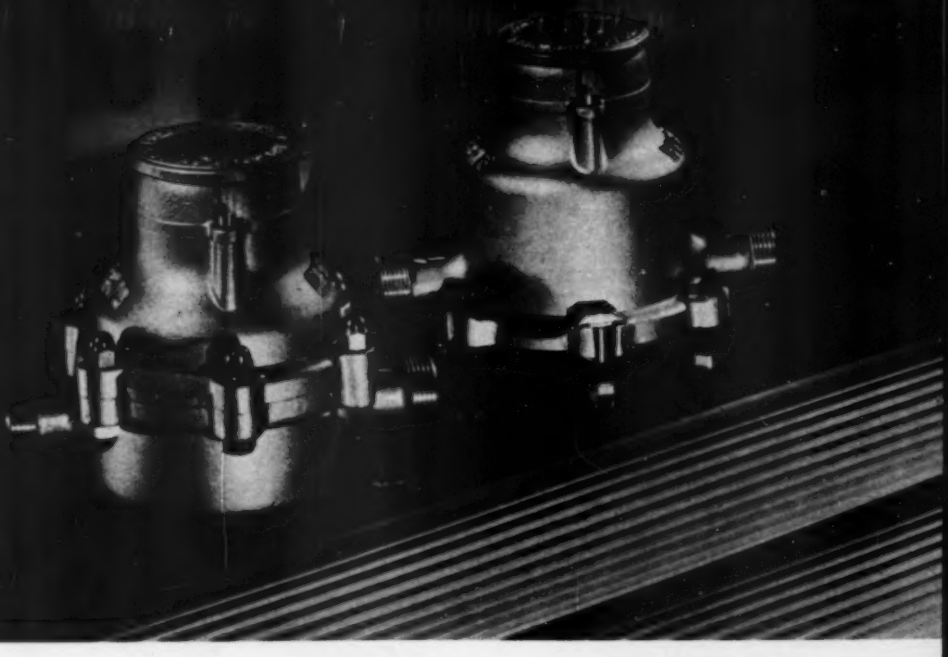
Barbara Fritchie's house in Frederick, Maryland as it appeared in the year 1866

The City of Frederick has a cast iron water main in service that was laid in 1845, seventeen years before Barbara Fritchie's flag-waving defiance of "Stonewall" Jackson's army. The changing channel of a creek undermined her humble home, now replaced in replica to serve as a museum. Yet Frederick's 106-year-old cast iron main, like many others, has survived the changing conditions of a century. Shock-strength, beam-strength and crushing-strength are inherent in cast iron pipe. Because of these strength-factors and effective resistance to corrosion, cast iron water and gas mains, laid over 100 years ago, are still serving in the streets of 38 cities in the United States and Canada. **United States Pipe and Foundry Co., General Offices, Burlington, N. J. Plants and Sales Offices Throughout the U. S. A.**

U.S. PIPE

NUMBER NINE OF A SERIES

HERSEY



HERSEY WATER METER POPULARITY

Is Greater Today Than Ever

REASON: The basic engineering design has never been equaled

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
SAN FRANCISCO — LOS ANGELES

Yardley PLASTIC PIPE for water or waste disposal systems

Whatever the need . . . for cold water or corrosive liquids, suction or discharge . . . there's a Yardley Plastic Pipe for the job.

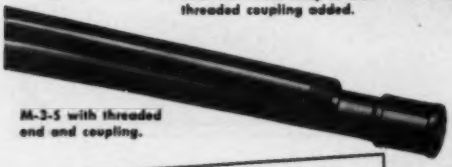
Made from rigid or flexible light-weight material. Acid and alkali resistant. Won't rot, rust or corrode. Produced in a full range of pipe and tubing sizes, ½" through 6". Complete line of standard fittings and adapters. Easier to install, more economical to handle.

Send for chemical resistance charts.

M-6 with cement-type sleeve coupling.

M-2 flexible type.

M-6 with male adapter and threaded coupling added.



M-3-5 with threaded end and coupling.

YARDLEY PLASTICS CO.
142 Parsons Ave. · ADams 9315
Columbus 15, Ohio

YARDLEY M-1 and M-2 FLEXIBLE PIPE SPECIFICATIONS

PIPE SIZE	NOMINAL O. D.	NOMINAL I. D.	CALCULATED B. P. P. S. I.	APPROXIMATE WT. PER FT.	NOMINAL SHIPPING LENGTHS
½"	.830	.630	540#	.093	600' Coils
¾"	1.050	.800	350#	.141	400' Coils
1"	1.340	1.100	300#	.179	300' Coils
1¼"	1.660	1.360	280#	.263	200' Coils
1½"	1.900	1.610	200#	.327	200' Coils
2"	2.375	2.067	170#	.434	200' Coils
3"	3.500	3.068	165#	.899	100' Coils
4"	4.500	4.026	130#	1.230	25' Straight
6"	6.675	6.065	115#	2.400	25' Straight

YARDLEY M-3-5 RIGID PIPE SPECIFICATIONS

PIPE SIZE	APPROXIMATE WT. LBS. PER FOOT	NOMINAL I. D.	NOMINAL O. D.	CALCULATED BURST PRESS. P.S.I. at 180° F.
½"	.118	.622	.840	1000
¾"	.161	.824	1.050	900
1"	.213	1.030	1.315	800
1¼"	.316	1.380	1.660	700
1½"	.378	1.610	1.900	600
2"	.505	2.070	2.375	500
3"	1.050	3.068	3.500	451
4"	1.470	4.026	4.500	410
6"	2.360	6.065	6.625	320

YARDLEY M-6 RIGID PIPE SPECIFICATIONS

PIPE SIZE	APPROXIMATE WT. PER FT.	NOMINAL I. D.	NOMINAL O. D.	CALCULATED BURST PRESSURE P.S.I. AT 180° F.
½"	.052	.476	.600	700
¾"	.090	.715	.855	625
1"	.138	.970	1.140	550
1¼"	.20	1.230	1.430	525
1½"	.22	1.510	1.720	490
2"	.45	2.00	2.350	400
3"	.585	3.000	3.350	375
4"	.880	4.000	4.300	340
6"	1.940	6.000	6.400	335

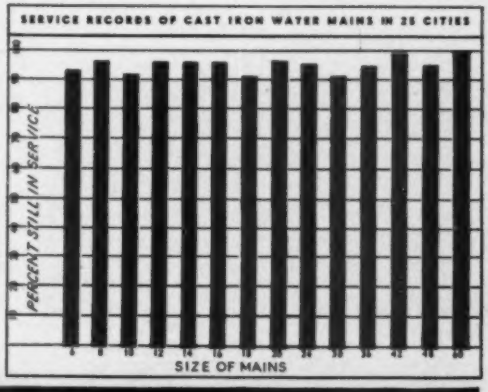
M-6 and M-3-5 recommended for working pressures up to 20% of calculated bursting pressures where temperatures do not exceed 125°. For M-1 and M-2 working pressures, use 50% of calculated burst.

No doubt about the stamina

Service Records of Cast Iron Water and Gas Mains
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
• Black dots represent original cast iron mains in service
★ Red stars represent cast iron mains in service 100 years or more

AMERICA PROVES IT! The above map shows cities having some or all of their *original* cast iron water or gas mains still in service. The red stars indicate 34 cities having cast iron water or gas mains in service that were laid a century or more ago.

SURVEYS PROVE IT! A recent study directed by 3 Water Works Associations shows that 96% of all cast iron water mains, 6-inch and over, *ever laid* in 25 representative cities, are still in service.



CAST IRON PIPE

of CAST IRON PIPE...

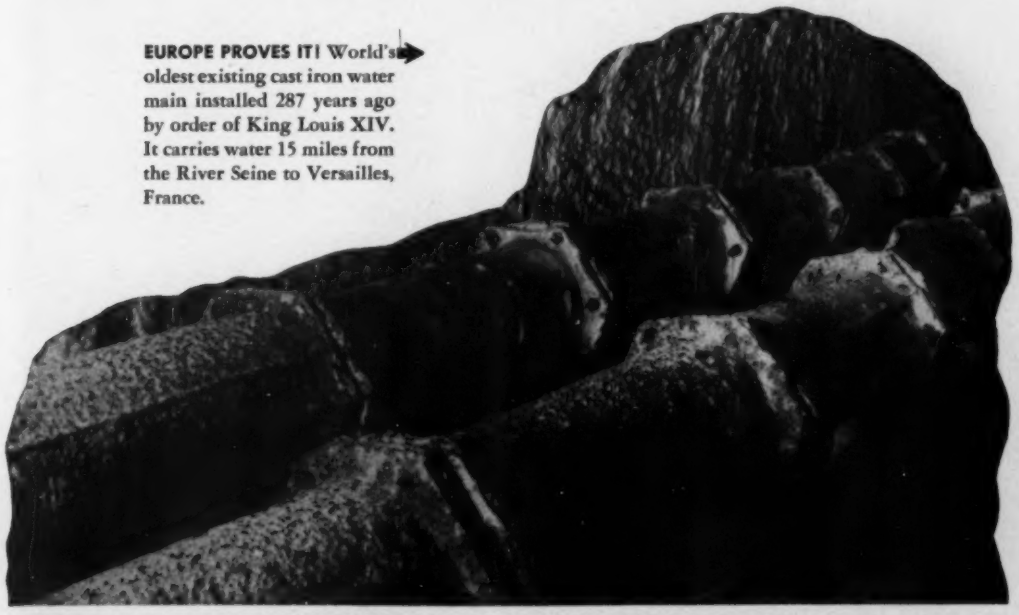
Europe proves it! The oldest cast iron water mains in the world, by authenticated records, supply the town and parks of Versailles, France. They were installed in 1664 and are still functioning after 287 years of service. Other cities in France, Germany and the British Isles have cast iron mains in service that are over 100 years old.

America proves it! Original cast iron mains are still serving 57 of America's largest cities. And 34 cities have either cast iron water or gas mains in service that were laid over 100 years ago (see map).

Surveys prove it! An exhaustive study, directed by a Joint Committee representing 3 Water Works Associations, shows that 96% of all cast iron water mains, 6-inch and over, *ever laid* in 25 representative cities, are still in service (see chart).

Yes, history proves beyond doubt that cast iron pipe has the stamina and the strength-factors that pipe must have to serve dependably under the paved streets of cities, towns and villages.

EUROPE PROVES IT! World's oldest existing cast iron water main installed 287 years ago by order of King Louis XIV. It carries water 15 miles from the River Seine to Versailles, France.



CAST IRON PIPE RESEARCH ASSOCIATION; THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

SERVES FOR CENTURIES

Designs from engineers' notebooks

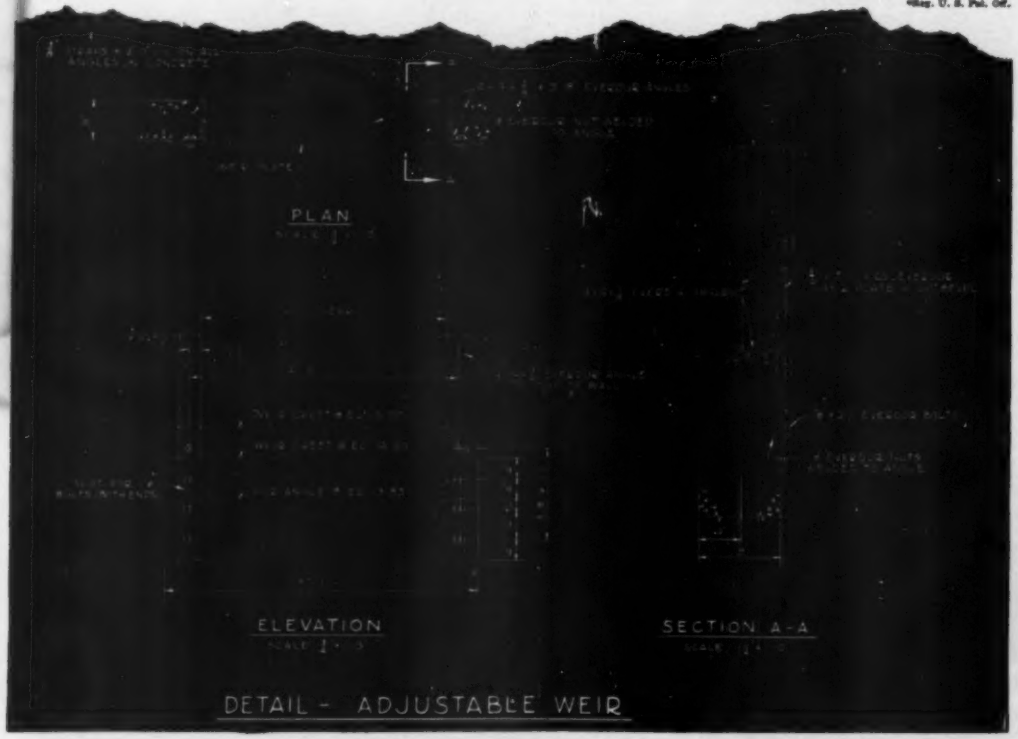
Weir with EVERDUR plate

This weir, specified by John J. Baffa, Consulting Engineer, New York, is designed to assure sustained and accurate water-level control. This, in turn, requires that the crest of the plate be capable of retaining a sharp edge against corrosion and erosion.

EVERDUR* (ANACONDA Copper-Silicon Alloys) was selected as an ideal structural material for this design for its corrosion-resistant properties, its strength and toughness and for the ease with which it can be fabricated by all conventional methods. The ease of machining and welding Everdur, for example, permits mounting nuts to be welded to the angles which form the frame, permitting the use of stud bolts. Plate, angles, stud bolts and nuts in this design are all of Everdur.

Everdur is widely used in sewage and waterworks installations, for screens, screen enclosures, tanks, hangers, brackets, fittings, gates, valves, stems, guides, seats, sealing strips, manhole steps and anchors, and many other applications for its great strength, high resistance to corrosion, and its good machining, forging and welding properties. For detailed technical information regarding Everdur, write to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. B146

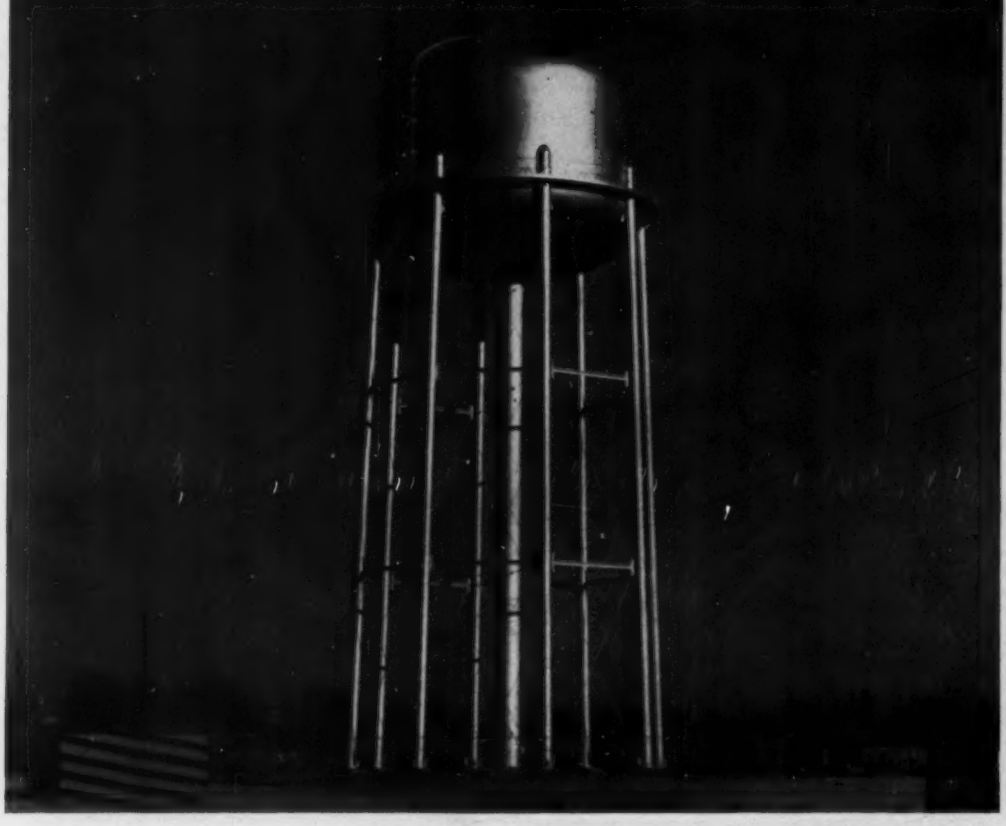
*Reg. U. S. Pat. Off.



SPECIFY EVERDUR ANACONDA® COPPER-SILICON ALLOYS

STRONG— WELDABLE— WORKABLE— CORROSION-RESISTANT

Horton Elevated Tank Helps Maintain Uniform Pressure in Monahans Water System



GRAVITY water pressure provided by a Horton elevated tank is "just what the doctor ordered" when it comes to reducing pressure variations in a water distribution system. The 500,000-gallon Horton elevated tank shown above was installed to provide gravity water pressure for the residents of Monahans, Texas.

The advantages of gravity pressure go farther than just improving distribution system pressures. Pumping costs can be lowered because the tank can be filled during the early morning hours when power rates are lower. Horton elevated tanks also provide a water reserve that guards against fire hazards. This added protection frequently results in better insurance classifications and reduced fire insurance premiums. To learn how you can provide sufficient capacity and pressure to meet growing water demands write our nearest office for full details.

Above: 500,000-gallon Horton ellipsoidal-bottom elevated tank, 94 ft. 6 in. to bottom, in the water system at Monahans, Texas. Horton ellipsoidal-bottom elevated tanks are built in standard capacities from 15,000 to 500,000 gallons.

HORTON

WELDED STEEL

STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

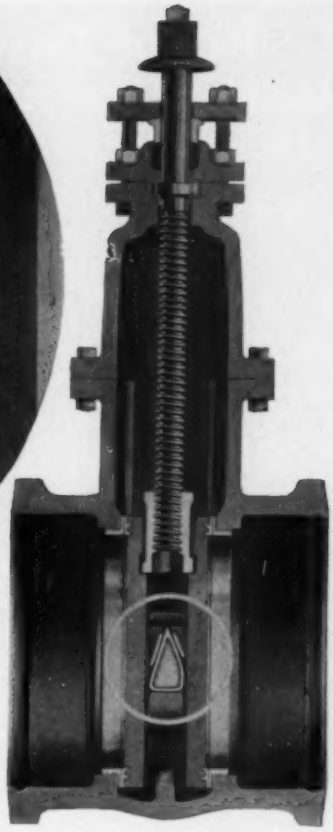
Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

Atlanta 3	2181 Healey Building	Los Angeles 17	1555 General Petroleum Building
Birmingham 1	1596 North Fiftieth Street	New York 6	3290-165 Broadway Building
Boston 10	1040-201 Devonshire Street	Philadelphia 3	1644-1700 Walnut Street Building
Chicago 4	2190 McCormick Building	Salt Lake City 4	550 West 17th South Street
Cleveland 15	2262 Guildhall Building	San Francisco 4	1583-200 Bush Street
Detroit 26	1551 Lafayette Building	Seattle 1	1350 Henry Building
Havana	402 Abreu Building	Tulsa 3	1646 Hunt Building
Houston 2	2115 National Standard Building	Washington 6, D.C.	1109 Cafritz Building

IT'S ALL IN THE *Wedge*

THE SHORT SIDE
The gate on this side is pulled first. This quickly releases wedging pressure on both gates.

THE LONG SIDE
of the Wedge causes a powerful seating action of both gates.



THE RENSSELAER WEDGE GIVES

Easy OPENING *Tight* CLOSING

Yes, the first turn of the valve stem mechanically starts one gate first. This at once unwedges both gates — no dragging — easy lifting. In closing, both gates are wedged tight shut WHEN they reach the closing point opposite their seats, not before. This minimizes friction, wear. All Rensselaer Double Disc Gate Valves in sizes 10" and larger have SOLID BRONZE Wedges for smoother and more positive closing and opening.

Other Rensselaer features include SOLID BRONZE parts subject to wear. Castings are high tensile strength corrosion-resistant iron. Interchangeability of parts insures low maintenance cost. There are thousands of these fine valves in use. Ask your Rensselaer representative for further information on these and other Rensselaer products.

TEN POINTS OF SUPERIORITY

1. Easy to Operate — No binding of Stem; Wedges independent of Stem and Stem Nut can't bind.
2. Stems and Stem Nuts both SOLID BRONZE.
3. Wedges, SOLID BRONZE in sizes 10" and larger. Wedges in these sizes have long and Short Wedging Surfaces. Long side insures greater power in Closing. Short side, maximum ease in Opening.
4. High Tensile Strength, Corrosion Resistant Iron.
5. Stuffing Box Bolts rust-proofed. Nuts BRONZE.
6. Easy to Repack — ample stuffing box depth and diameter.
7. Minimum wear on Rings — Gates Seat, Unseat, in "fully closed" position.
8. Parallel, collapsible Discs — no sticking in closed position or binding of Stem due to tipping.
9. Interchangeable parts — due to precision Casting and Machining.
10. Long Life — Thousands still operating perfectly, some after 50 years.

LEADERSHIP FOR OVER 65 YEARS

RENSSELAER VALVE COMPANY

Hydrants • Gate Valves • Square Bottom Valves
Check Valves • Tapping Sleeves and Valves • Air Release Valves

TROY, NEW YORK

Division of Neptune Meter Company

14

Atlanta, Ga.; Bala-Cynwyd, Pa.; Chicago, Ill.; Dallas, Texas; Denver, Colo.; Glendale, Cal.; Haverhill, Mass.; Kansas City, Mo.; Memphis, Tenn.; New York City; Oklahoma City; Pittsburgh, Pa.; San Carlos, Calif.; Seattle, Wash.

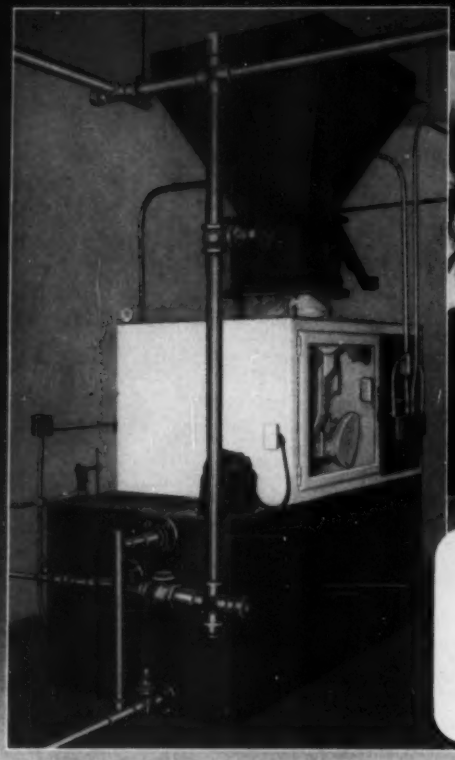
BRADENTON, FLA.

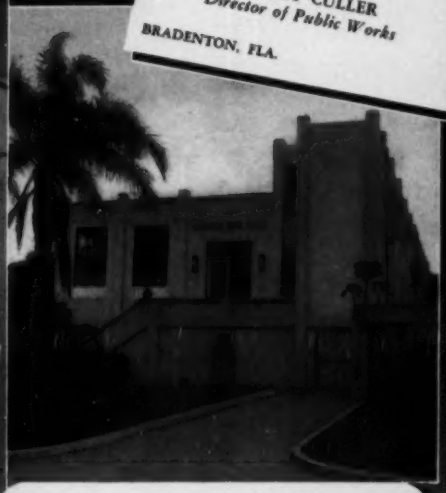
Water Works

(ADDITION COMPLETED IN 1949)

C. K. S. DODDS
Consulting Engineer
SARASOTA, FLA.

RAMSEY CULLER
Director of Public Works
BRADENTON, FLA.





Omega Equipment furnished for the Bradenton Water Works:

1—44-20A Belt Gravimetric Feeder arranged for proportional control.
Extension hopper
Lead-lined dissolving chamber
High speed mixer
1—Laboratory Stirrer

In recent years, many Southern cities have undergone rapid population increases and Bradenton, Fla., is a good example of this. Located in the heart of the "Grapefruit League", Bradenton is the scene of many pre-season games between the major league baseball clubs. The annual influx of tourists plus the steady growth of the resident population imposed too heavy a burden on the Bradenton Water Works. The solution: an addition to the plant which increases its maximum rated capacity from 2 to 4 MGD.

Raw water is drawn from Lake Ward, about 6 miles from the Water Works. An Omega Belt Gravimetric Feeder, specified by the Engineer and installed by the Contractor, Ivy M. Smith Co. of Jacksonville, Fla., delivers alum in solution at rates proportional to the flow of influent. This Feeder, together with its auxiliary equipment, provides chemical feeding of great accuracy and assures the correct alum dosage for proper coagulation. For Bulletins describing Omega Water Works Equipment, address Omega Machine Co. (Division of Builders Iron Foundry), Providence 1, Rhode Island.

BIF INDUSTRIES

OMEGA
THE LAST WORD IN FEEDERS

Ω OMEGA

To move 1,000,000 gallons of water per day for 21 miles

"Century"® ASBESTOS-CEMENT PRESSURE PIPE

New one-million-gallon-a-day water main of "Century" Asbestos-Cement Pressure Pipe being laid to serve the Southwestern Potash Corp. plant near Carlsbad, New Mexico. Installation Contractor: Western Construction Company, Hobbs, New Mexico.

In the wide open spaces of New Mexico, well over 100,000 feet of 12" "Century" Pipe will serve the requirements of this important industry. "Century" Pipe is also serving municipal and privately owned water companies throughout the United States and setting new standards for water main economy and service.

Consider the economy: "Century" Pipe is moderate in initial cost. Though exceptionally strong, it is light in weight — is economical to ship and to store; can be handled easily and laid quickly. With "Century" Simplex Couplings, even curves up to 5° deflection per pipe length can be laid rapidly.

Fast, easy laying means real savings on installation costs!

The service is certain! "Century" Asbestos-Cement Pressure Pipe cannot rust; is highly resistant to soil corrosion; tuberculation and electrolysis cannot affect it. In fact, so permanently strong is "Century" Pipe that it can always be recovered and relaid in its original pressure class—an economy "plus" worth remembering!

Before you buy or specify any pipe for water mains, get the cost-saving story of "Century" Asbestos-Cement Pressure Pipe. Write us for specifications and an informative booklet, "Mains without Maintenance."

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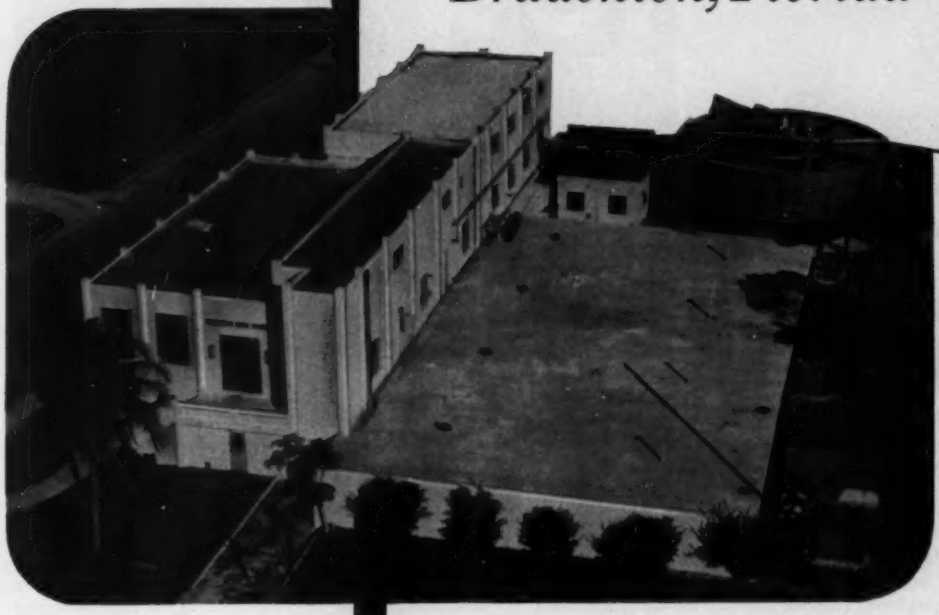
K&M ASBESTOS ROPE
for yarning bell and spigot joints will not promote the breeding of bacteria. Write for details.

Accelator® *solves high color problem for Bradenton, Florida*

Remodeled plant designed by
C. K. S. Dodd, Engineer
Sarasota, Florida



2800 G.P.M. Accelator —with automatic chemical feeders and central control. Forced draft Aerator 8 Filters, 12x15 ft. Clarifies, filters, removes color, chlorinates and ammoniates up to 4 m.g.d.

Aerator **AFTER** *coagulation reduces CO_2 to 5 p.p.m.*

River water of high color (up to 400 p.p.m.) and low alkalinity (down to 8 p.p.m.) is cleaned and polished in this modern Infilco installation. Accelator clarification, followed by forced draft aerator, reduces CO_2 content to 5 p.p.m., produces bright, clear, non-corrosive effluent for final filtration.

CLEARER WATER FASTER with exclusive slurry recirculation
SAVE UP TO 80% IN SPACE (with lower construction costs)
SIMPLER OPERATION — mixing, coagulation, clarification and sludge removal all in one unit
FASTER CHEMICAL REACTION • HIGHER RATINGS

INFILCO
• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1934 •

INFILCO INCORPORATED | *Tucson, Arizona*

FIELD ENGINEERING OFFICES IN 26 PRINCIPAL CITIES

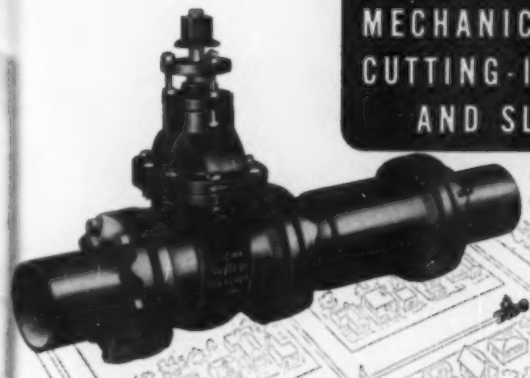
World's Leading Manufacturers of Water Conditioning and Waste-Treating Equipment

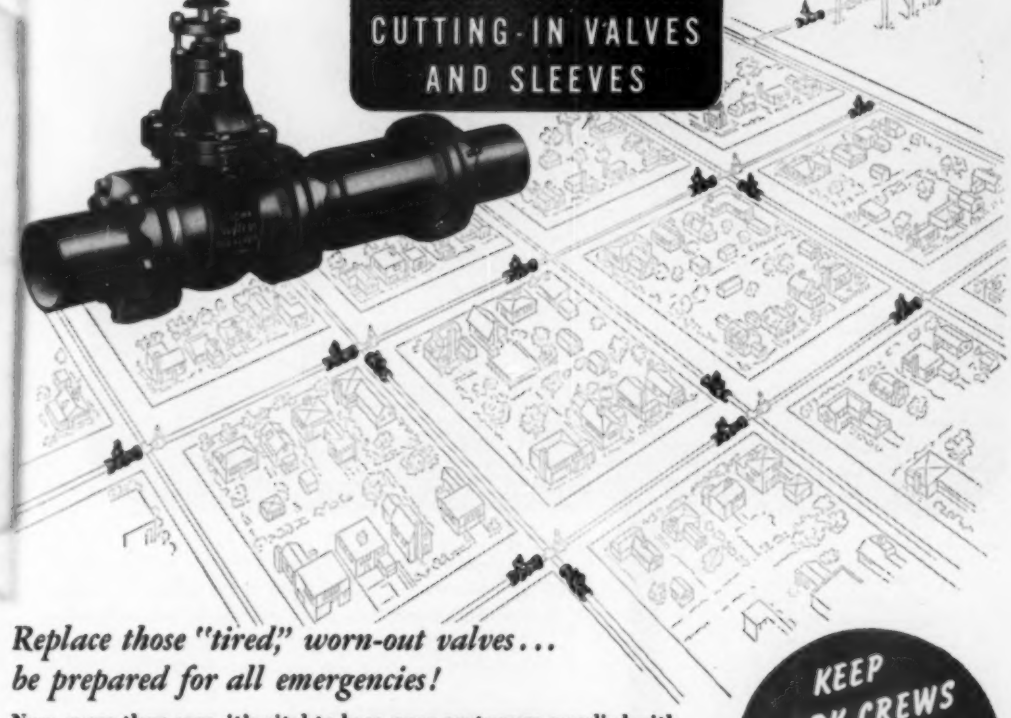
ACT NOW!

rehabilitate your water system and give it new life with . . .

IOWA

MECHANICAL JOINT CUTTING-IN VALVES AND SLEEVES





Replace those "tired," worn-out valves . . . be prepared for all emergencies!

Now, more than ever, it's vital to keep your customers supplied with water and fire protection at all times . . . Replace worn-out valves and add needed valves with IOWA Mechanical Joint Cutting-In Valves and Sleeves . . . It's the fastest, simplest and most economical method of cutting gate valves into existing water lines . . . Furnished complete with joint accessories . . . No lead, no jute, no caulking . . . Just a ratchet wrench . . . Ideal as auxiliary valves for fire hydrants . . . Simplifies hydrant inspection and maintenance . . . Act now before it's too late . . . Write today for descriptive literature!

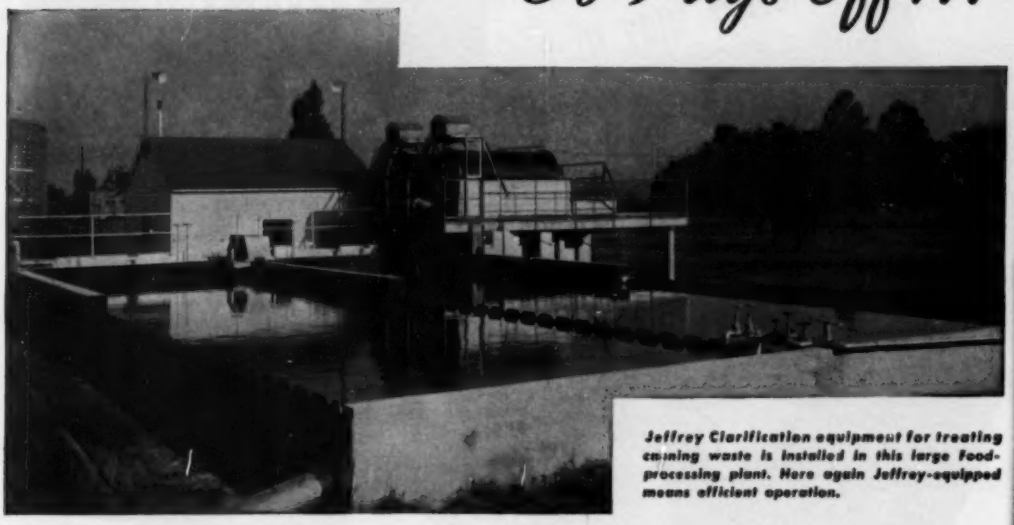
KEEP WORK CREWS BUSY ON JOBS LIKE THIS . . . IT PAYS!

IOWA VALVE COMPANY

201-299 N. Talman Ave., Chicago 80, Ill. • *A Subsidiary of James B. Clow & Sons*

TREAT INDUSTRIAL WASTE RIGHT

It Pays Off...



Jeffrey Clarification equipment for treating canning waste is installed in this large Food-processing plant. Here again Jeffrey-equipped means efficient operation.

Industrial Waste is the Peck's Bad Boy in nearly every plant . . always in bad with the neighbors as well as State Pollution Control Commissions.

Clarification of industrial waste need not be such a bad problem. Jeffrey has the facilities for proper and efficient waste treatment . . can help you keep the nation's waters clean. For meeting exacting specifications we can furnish Collector mechanisms for Grit Chambers and Settling Basins, Screens, grease and oil Skimmers, Flocculation equipment, etc., backed by years of experience in designing and building the best in Sewage and Water treatment equipment.

We will be glad to send you some of the names of outstanding plants in which Jeffrey equipment is doing a real job on the purification of sewage and concentrated organic wastes . . and paying off. May we hear from you?

Bar and Disc-type Screens
Sludge Collectors
Sludge Elevators
Grit Washers and Collectors

FLOCTROLS (controlled flocculation)
Equipment for Biofiltration plants
Transmission Machinery
Scum Removers
Garbage Grinders

Chemical Feeders
Screenings Grinders
Belt and Spiral Conveyors
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Established 1877

996 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

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Jeffrey Mfg. Co. Ltd., Montreal, Canada
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IN SYRACUSE, NEW YORK—On this gravity line, joints had to be completely leakproof to prevent possible infiltration of polluted ground water. Syracuse engineers specified a Dresser-Coupled steel line with confidence based on many years of experience with this type of construction.

A DRESSER-COUPLED STEEL LINE delivers water cheaper

Be Sure you get the best line at the best price. Put steel pipe and Dresser Couplings in your specifications.

The cheapest way to deliver water to the place where it turns into revenue is with a Dresser-Coupled steel line—the line that cuts *installation* costs, *leakage* losses and *maintenance* costs.

Once you have discovered the ease of construction and the lasting dependability of such a line you'll know why more and more engineers specify them every year. Long, strong sections of steel pipe are easily put in place and the joints are easily made by any labor. Construction proceeds quickly, even in wet weather.

Leakage losses are prevented by controlled gasket pressure which is the result of controlled bolt tightness around the joint. Dresser Couplings stay "flexible-tight" even in stressed locations.

Maintenance is cut to the bone, too. Joints last for life, and the absence of heat in joining prevents damage to glass-smooth pipe linings. High carrying capacity is sustained.

Experience all over the world proves that a Dresser-Coupled steel line gives you the ultimate in performance and economy. See your Dresser Sales Engineer or write our Bradford Office for literature.

DRESSER

"FLEXIBLE-TIGHT"

COUPLINGS

Dresser Manufacturing Division, 50 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Boyshore Highway, South San Francisco, California. Sales Offices: New York, Philadelphia, Chicago, Houston, South San Francisco. In Canada: 629 Adelaide Street, W., Toronto, Ontario.

Taste and Odor JOURNAL

PALATABLE WATER IS THE GREAT ASSET OF EVERY COMMUNITY, and it IS possible in your Water Plant

Leo Louis, well known superintendent of the City of Cedar Rapids, Iowa, Water Department, with years of experience in the Sanitary Engineering Field of Public Health, says:

"Every water works man knows that water works production is a 24-hour a day job, 365 days a year. Likewise, the managers of water supplies troubled by periodic onsets of taste and odor producing raw water know that we must do our best to constantly maintain a taste and odor free water at the customers' tap. This means that we must use every available chemical method known to the water works profession to treat these waters. The water consuming public may forget to commend us on producing a palatable water, but they will not forget to criticize us for permitting a taste and odor condition to persist in the system."

Aqua Nuchar Activated Carbon has been used to remove tastes and odors from public water supplies for over 20 years by simply adsorbing taste and odor producing compounds. The manufacturers of Aqua Nuchar offer the services of Threshold Odor Specialists to assist water purification plants solve their taste and odor problems. Write, wire or 'phone our nearest office today!

NOTE: This advertisement is published with the idea of promoting production of uniformly palatable water, and the quotations from outstanding water works authorities should not be construed as being an endorsement of any particular product.

INSURES PALATABLE NUCHAR DRINKING WATER

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PURE OIL BLDG. 35 E. WACKER DRIVE CHICAGO 1, ILL.

OTHER PRODUCTS: Snow Top Precipitated Calcium Carbonate—Nuchar Activated Carbon—Ligro Crude Tall Oil —Talloco Tall Oil Pitch—Indusoil Distilled Tall Oil—Tallex Abietic Acid—Polycel Cellulose Fibers—Indulin (Lignin)

Saved!

...Hundreds of Man-Hours on New Installations

YOU

CAN NOW DO AN ALL MECHANICAL-JOINT JOB WITH PIPE, FITTINGS, VALVES AND HYDRANTS

...with EDDY Mechanical-Joint Valves

After excavation, two unskilled workmen and a ratchet wrench can install Eddy Mechanical-Joint Valves in a jiffy. This can mean many man-hours saved each year. What's more, the work can be done in a flooded trench, or in any kind of weather—for no caulking, no lead-melting is needed . . . and all joints are *bottle-tight* under pressure. Valves meet AWWA specifications, and are available in sizes 3" to 12" for use on both sand-cast and centrifugally-cast iron water pipe.

...and EDDY Mechanical-Joint Fire Hydrants

Since 1849 EDDY For Long Service

Mechanical-Joint connection allows quick, easy installation or removal (with or without auxiliary valve). Hydrants also available with bell or flanged connection. All operating parts accessible by removing top cover. Hydrants open fast, close easily. Even a bent stem does not cause water loss, and drip-action prevents freeze-up. Stock up now on both Clow Mechanical-Joint Cutting-in Valves and Hydrants. Be ready to make easy, speedy installations when needed!

EDDY VALVE COMPANY

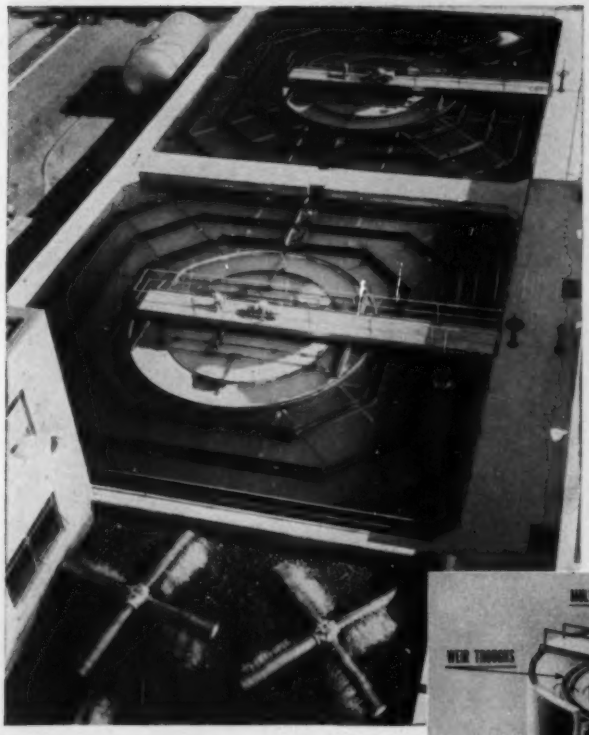
WATERFORD NEW YORK

A Subsidiary of James B. Clow & Sons

the CLARIFLOW

ECONOMICAL ANSWER TO MOST PROBLEMS OF

- WATER SOFTENING
- CLARIFICATION AND COLOR REMOVAL
- INDUSTRIAL WASTE TREATMENT



The CLARIFLOW will produce better water for you because it gives complete control . . .

The CLARIFLOW gives control over each individual function of controlled reaction stage flocculation, vertical clarification and positive slurry thickening and removal.

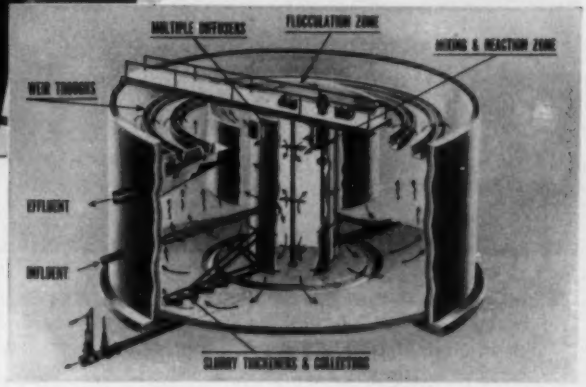
Initial mixing and reaction done in an isolated mixing tank insuring complete reactions.

Exclusive Multiple, tangential diffusers simultaneously and equally distribute flow to avoid "tendencies" and initiate slow flocculation.

Recirculation of precipitate for catalyzing purposes is positive and controllable. Erratic "Blanket Filtration" is not practiced.

Thickeners used to scrape settled slurry to the blow-off point.

Exclusive *Balanced* multiple surface weir troughs make efficient use of short detention periods and insure clarified overflows.



Orlando, Florida
Clariflow Installation

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WALKER PROCESS EQUIPMENT INC.
FACTORY • ENGINEERING OFFICES • LABORATORIES
AURORA, ILLINOIS

SIMPLICITY of AMERICAN METERS

—THE MARK OF ULTIMATE REFINEMENT

Many devices that give us wonderful service today have passed through a period when their original simple designs became over-complicated, then by a process of refinement and simplification the best operating construction has been achieved.

This has happened with water meters. Design has been reduced to its simplest and most efficient form in the American Meter. As in the interchangeability of gear trains pictured, these are the ultimate in efficient simplicity.

Write for informative catalog today.

BUFFALO METER CO.

2909 MAIN STREET, BUFFALO 14, NEW YORK

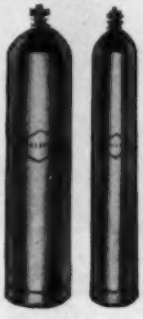
Chemicals you live by

UNLESS YOU WOULD LIKE CHLORINE IN A BUCKET...

Our biggest problem in supplying you with cylinder chlorine today isn't the lack of chlorine—it's getting the empty cylinders back from your plant. In other words, to keep a continuous flow of chlorine going from our plants to you, we must have your empty cylinders returned to us.

The M-31 order assures you an adequate supply of chlorine so there is no need for any consumer to worry or to overstock. But M-31 does not take care of getting the empties back from you to us. Without empty cylinders we cannot renew your order.

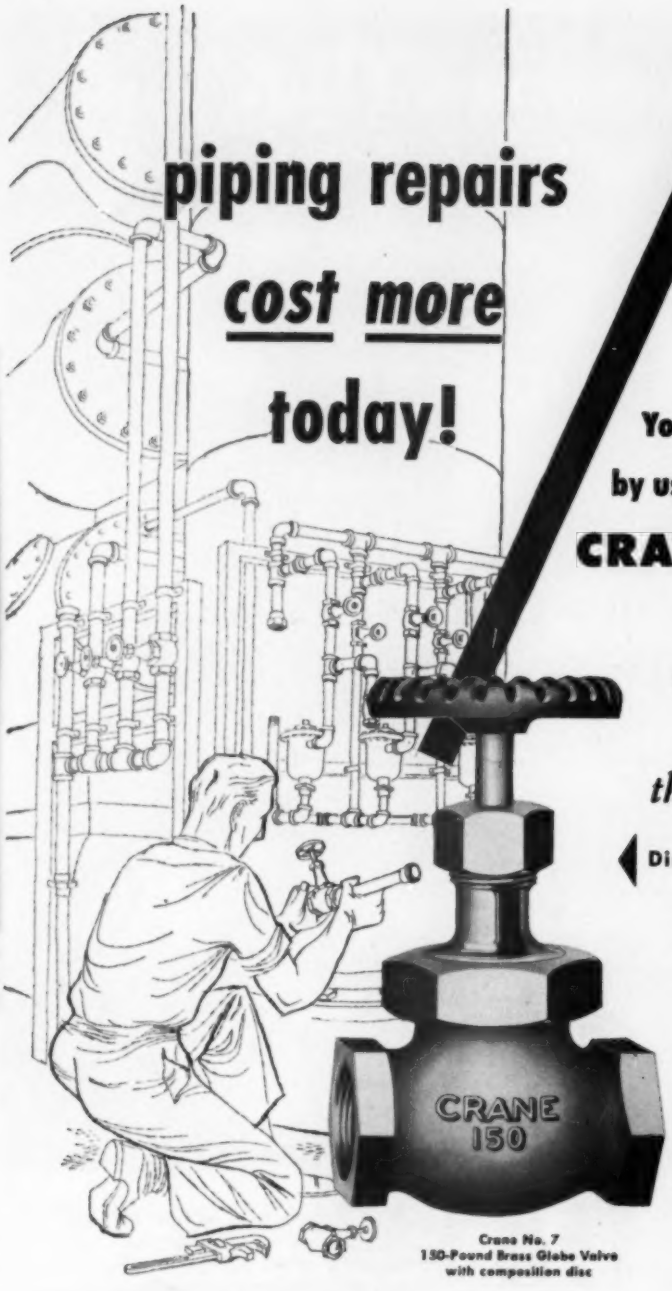
To help us give you prompt delivery—please return empties as fast as possible and please do not keep more cylinders standing around than necessary for reasonable protection of your supply.



DIAMOND ALKALI CHLORINE

DIAMOND ALKALI COMPANY • CLEVELAND 14, OHIO

DIAMOND ALKALI CHEMICALS



Crane No. 7
150-Pound Brass Globe Valve
with composition disc

piping repairs *cost more* today!

You spend less
by using Dependable Quality
CRANE VALVES

. . . That's why more Crane Valves are used than any other make

Disc repairs made in a minute

You save maintenance time and money when you use Crane No. 7 Brass Valves with composition disc. When a leak shows up, you don't change valves . . . just open the bonnet joint and slip on a spare disc holder with a new disc already in it.

And by changing the type of disc, you can adapt No. 7 valves to a wide range of services—steam, hot water, cold water, air, oil, gas, and gasoline. Made in globes and angles; screwed or flanged ends.

Simplified maintenance and complete adaptability to your service typify Crane Quality valves and fittings for every need. That's why they cost less in the long run.

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"WORK-TEAM"

of the irrigation industry

For heavy production at extra low operation cost, Layne built wells and Layne vertical turbine pumps are the most widely used work-team of the irrigation industry. Thousands of installations in well water irrigation areas have unmatched records of high efficiency and dependability. Capable of producing great quantities of water cheaply, they make well water irrigation a profitable business. Furthermore, their superior quality and rugged construction can always be depended on to provide years and years of fine service at extremely low upkeep cost.

IDAHO—One of the two 1,800 gallons per minute Layne vertical turbine pumps installed for irrigating potatoes, wheat, peas and hay crops.

NEBRASKA—An angle gear drive Layne vertical turbine pump powered with a gasoline engine. Installation is for irrigation corn and other grain crops.

The same type wells and pumps installed for irrigation are also the Nation's most widely used by cities, factories, railroads and processing plants of all kinds. All are built complete by Layne and Layne alone. No other make is so generally recognized for highest efficiency and longer lasting service. No other is so thoroughly proven by actual field performance records.

NEW CATALOG ON WATER SYSTEMS

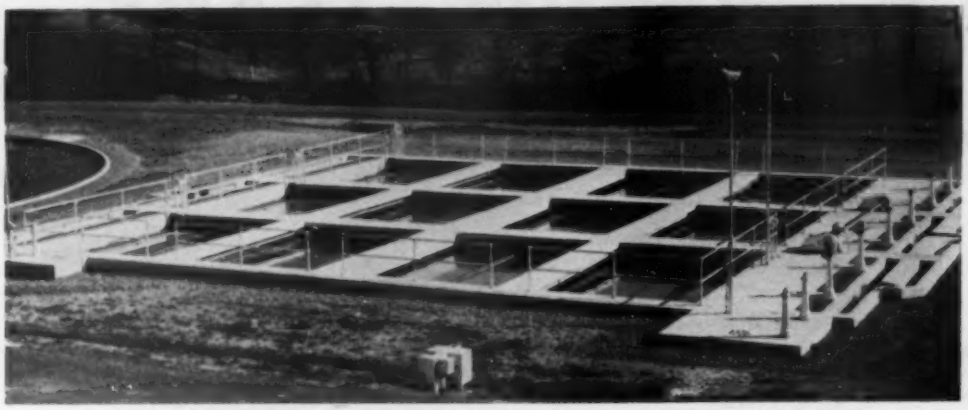
Fifty-two pages of vitally interesting and helpful information on the Layne method of building well water systems; tubular and rock wells, special drilling services, shutter screens and vertical turbine pumps with a section on engineering and useful tables. A copy will be sent without obligation if requested on company letterhead.

LAYNE & BOWLER, INC. GENERAL OFFICES, MEMPHIS 8, TENN.

Layne

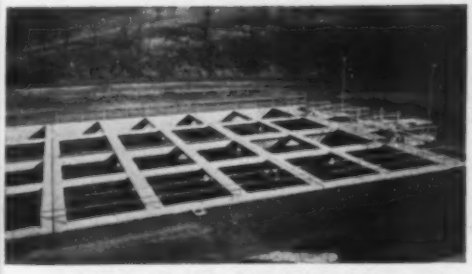
WATER SUPPLY

WELLS & PUMPS

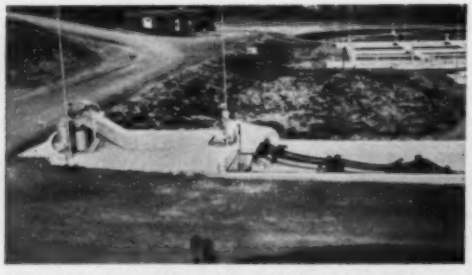


ROTOLINE SKIMMERS and Straightline Sludge Collectors in three 20 x 70 ft. primary settling tanks reduce suspended solids 59%, under actual operating conditions, in 1.76 hour detention time. Settling rate is 1220 gpd per sq. ft. tank area.

How to treat sewage for ¼¢ per day per capita



STRAIGHTLINE SLUDGE COLLECTORS — two longitudinal and one cross type — convey sludge to sumps in four 33 x 115 ft. final settling tanks. Peak-cap bearings, pivoted flights and "Straightline" action provide a positive, efficient combination.



STRAIGHTLINE GRIT COLLECTOR AND WASHER for 30 ft. grit chamber effectively collects, washes and removes settled grit — separates it from putrescible organic matter. Long-wearing Promal collector chain and rugged screw conveyor give low-cost long life.

LINK-BELT equipment plays prominent role at efficient Winchester, Va. sewage treatment plant

A PIONEER in Virginia's intensified pollution-abatement campaign, the city of Winchester recently placed in operation a 2.4 mgd Bio-filtration Plant. Designed by Alexander Potter Associates, consulting engineers, the plant is giving excellent sewage treatment at an operating cost of only ¼ cent per day per capita.

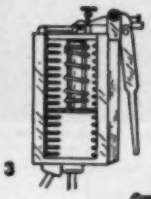
Major equipment used in this installation includes Link-Belt Straightline Sludge Collectors for all primary and final settling tanks, Rotoline Grease Skimmers and Straightline Grit Collector and Screw Conveyor-Washer.

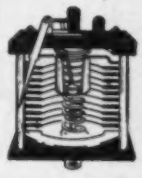
The complete L-B line is designed and built to highest standards and backed by more than 30 years' experience in this field. Link-Belt sanitary engineers will work with your engineers, chemists and consultants — help you get the best in modern liquid treatment.

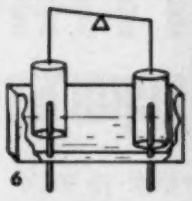
LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in principal cities. 12.100





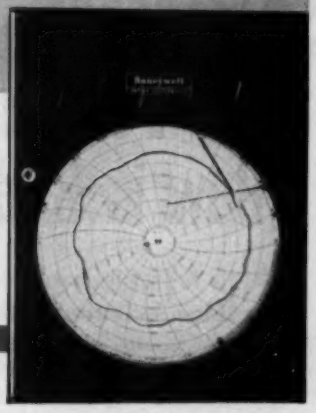


A Measuring Element

for

Every Range and Purpose

. . . with the Brown Recording Pressure Gauge



1 Hg-U Tube (Differential) 2 Spiral 3 Compound Spring and Bellows 4 Low Pressure Spring and Bellows 5 Intermediate Pressure Spring and Bellows 6 Furnace Pressure Draft

THE wide range of measuring elements available with the Brown Recording Pressure Gauge permits you to select a specific element for each pressure and liquid level application . . . from microns to tons . . . from corrosive to non-corrosive. This means you get precise measurement specifically suited to *your* application with a permanent record for filing and future reference.

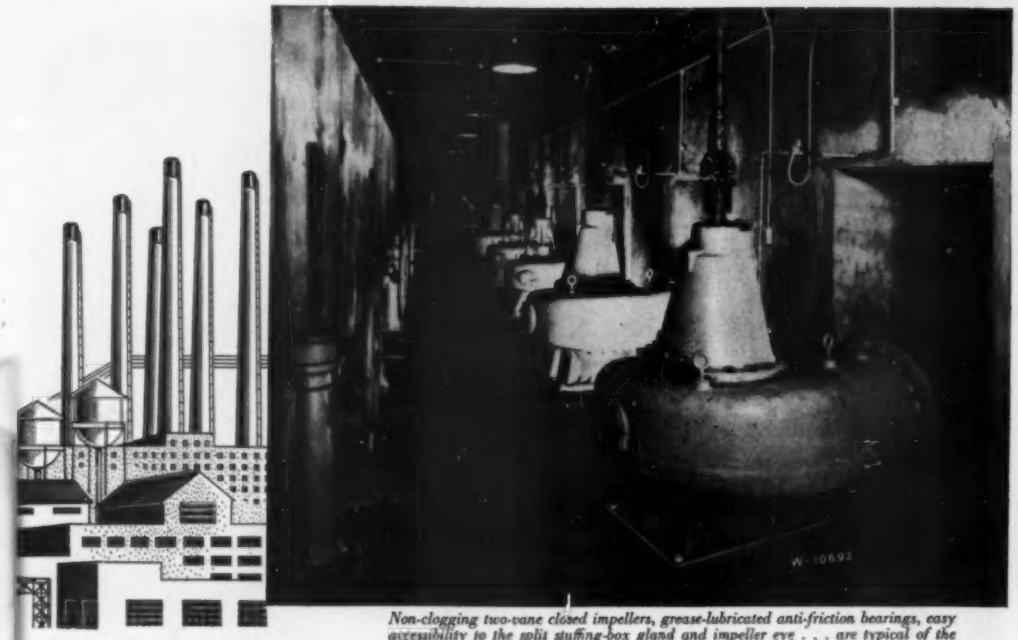
Recorders are available with single pen or with 2 or 3 pen combinations for pressure and level (or temperature) recordings on the same chart . . . with electric or pneumatic transmission for remote readings . . . as well as with electric or pneumatic control.

The Brown Pressure Gauge and its components are precision made . . . give continuous trouble-free performance. For detailed information write for Catalog 7000, or call in your local Honeywell engineer . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4575 Wayne Ave., Phila. 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

MINNEAPOLIS
Honeywell

Brown Instruments



Non-clogging two-vane closed impellers, grease-lubricated anti-friction bearings, easy accessibility to the split stuffing-box gland and impeller eye . . . are typical of the many Worthington MIXFLO features assuring low-cost, trouble-free sewage pumping.

How is Bridgeport's Sewage Pumped?

It's full of industrial waste . . . a problem built for Worthington Pumps

Here's another municipality which has turned its sewage pumping over to Worthington—100%.

These five Worthington Vertical MIXFLO sewage pumps are located in Bridgeport's Westside sewage plant—installed in 1946. Three are 20-inch, two are 16-inch MIXFLOS.

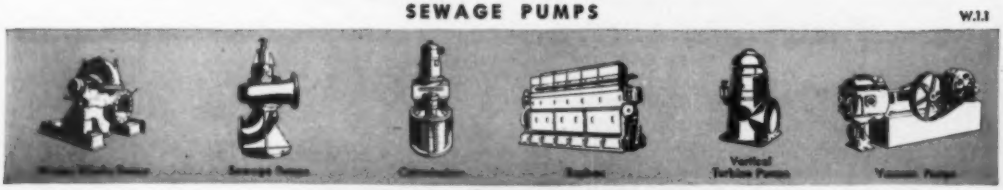
Bridgeport's Eastside plant duplicates these five pumps, and in addition uses two Worthington dry vacuum pumps and a Worthington air compressor.

In many other places, too, Worthington—world's largest manufacturer of pumps—is keeping pace with developments in sewage treatment and disposal by furnishing pumps of utmost dependability.

The Worthington MIXFLO line offers the industry's widest choice of sizes and types. So take a tip from New York, Chicago, Philadelphia, Bridgeport—find out why *there's more worth in Worthington.* Write Worthington Pump and Machinery Corporation, Public Works Division, Harrison, New Jersey.

WORTHINGTON

SEWAGE PUMPS W.1.1



Common sense design assures easy operation

The stuffing box plate, cast integral with the head, combines with the packing and bronze stuffing box nut to seal off the operating thread. Nothing—water, sediment or ice—can reach the thread to damage it or hinder its operation. Winter or summer, the Mathews Modernized Hydrant is *dependable*—an important factor in neighborhood safety.

MATHEWS HYDRANTS

Made by R. D. Wood Company

Public Ledger Building, Independence Square
Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

Mathews Modernized Hydrants offer these advantages

Compression-type valve prevents flooding • Head turns 360° • Replaceable head • Nozzle sections easily changed • Nozzle levels easily raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • Operating thread only part to be lubricated • All working parts contained in barrel—removable without excavating • A modern barrel makes an old Mathews good as new • Available with mechanical joint pipe connections

You Need Both...

A Carryable HOMELITE PUMP

A Carryable HOMELITE GENERATOR

for emergency or routine repairs

Just for a guess, when will your men be called out on your next repair job... during the day or during the night?

True, you never can tell. And true again, you're ready for it if you have *both* a Homelite Pump and a Homelite Generator handy to toss in the back of a truck. Always you need the pump . . . because a Homelite self-priming gasoline engine-driven pump will handle as much as 15,000 gallons an hour and will keep seepage down to strainer level. And always it is comfortable to have a Homelite gasoline engine-driven generator handy. Because you can use it for operating floodlights on night work or for operating electric tools both day and night.

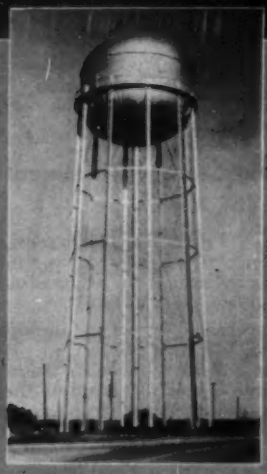
Have both ready . . . ready for any emergency. You'll save money . . . enough to pay for both . . . in much less time than you think. Write for a free on-the-job demonstration.

Manufacturers of Homelite
Carryable Pumps • Generators
Blowers • Chain Saws

PERFORMANCE · DEPENDABILITY · SERVICE

HOMELITE
CORPORATION

709 RIVERDALE AVENUE • PORT CHESTER, N. Y.



PITTSBURGH • DES MOINES

Stands for

BETTER WATER SERVICE *with* ELEVATED STEEL TANKS

Ample supply for peak demands—dependable, uniform pressures—reserve capacity for fire protection and pump interruptions . . . these and every other feature of desirable water service are gained through the right Pittsburgh-Des Moines Elevated Steel Tank for specific community needs. Determination of correct tank type and size is simplified by a consultation with experienced P-DM engineers. *Let us cooperate!*

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25). . . . 3416 Neville Island
NEW YORK (7). . Room 918, 270 Broadway
CHICAGO (3), 1222 First National Bank Bldg.
DES MOINES (8). . . . . 919 Tuttle Street
DALLAS (1). . . . 1223 Praetorian Building
SEATTLE . . . . . 926 Lane Street
SANTA CLARA, CAL. . . 625 Alviso Road

INCINERATORS TEAM UP WITH P.F.T. HEAT EXCHANGER TO HEAT SLUDGE

One of two P. F. T. No. 619 Heat Exchangers which have a designed heat transfer capacity of 2,300,000 B.t.u. per hour each, or a total of 4,600,000 B.t.u. per hour. The sludge piping is so arranged that heat may be applied to any one, or all, of the digesters simultaneously.

At Bird Island Sewage Treatment Works, Buffalo, N. Y.

Two P. F. T. No. 619 Heat Exchangers are installed in the digester control building which is located between the four P. F. T. 90-foot diameter floating cover digesters at the Bird Island Sewage Treatment Works, Buffalo, New York.

Raw sludge is preheated by passing through the sludge tubes of two P. F. T. No. 619 Heat Exchangers. It is inter-mixed with circulated digester liquor to inoculate the raw solids and to eliminate the discharge of cold material into the digesters. With the addition of this modern means of digester heating it is now possible to maintain uniform optimum temperature in all digesters. With high and variable loadings on these digesters, this was not possible with the original internal heating coils.

The hot water crculated through the heat exchangers is supplied from boilers and from the waste heat recovered from the sludge incinerators.

P. F. T. Gas Safety Equipment as described in Bulletin 221 is used throughout to assure safe utilization of the sewage sludge gas. P. F. T. Bulletin 235 gives complete details of P. F. T. Digester Heater and Heat Exchangers for external digester heating.

P.F.T. **PACIFIC FLUSH TANK CO.**

Waste Treatment Equipment Exclusively Since 1893

4241 RAVENSWOOD AVE. CHICAGO 13, ILLINOIS

NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

Less Infiltration

TRANSITE* SEWER PIPE offers two basic safeguards that minimize infiltration in sewer lines: *tighter* joints and *fewer* joints.

Transite's special sleeve-type joints make up tight and stay tight in service.
Its long 13-foot lengths reduce the number of joints in the system.

These safeguards cut down the volume usually allowed for infiltration, reducing sewage load on the treatment plant and conserving plant capacity for future needs. Where new treatment facilities are planned, this reduced infiltration may permit consideration of a smaller plant with resulting economies.

Other Transite Economies—Transite's long lengths help maintain uniform grades; fewer joints reduce turbulence in the line. These advantages, added to Transite's unusually smooth interior, mean better flow qualities (Kutter's n=.010). This often permits designing the system with flatter grades and shallower trenches. Or, as an alternate economy, pipe of smaller diameter may be specified.

Transite Sewer Pipe is made of asbestos, cement and silica by a special manufacturing process that employs steam curing to develop greater corrosion resistance and strength. It is available in four strength classes in sizes to 36", permitting selection of the pipe best suited to trench conditions, and frequently eliminating the need for concrete cradles.

For further details, write Johns-Manville, Box 290, New York 16, N. Y.

JM

*Transite is a Johns-Manville registered trade mark

.....Johns-Manville

TRANSITE SEWER PIPE...

***THE FIRST REAL PIPE THAT IS PLASTIC!**

CARLON . . . the outstanding pipe development of modern science . . . is tomorrow's pipe today. This new medium for fluid and gas transmission combines the inherent advantages of plastic with the desirable characteristics of metallic pipe to create unprecedented longevity, versatility and ease of installation.

Whether used for municipal water systems, sewage disposal, land drainage or other medium-pressure low temperature applications, CARLON has a trouble-free service life many times longer than ordinary pipe. It is guaranteed against rot, rust and electrolytic corrosion and will not accumulate scale or sediment. CARLON is inert to the chemical action of corrosive soils and waters.

CARLON plastic pipe is shipped in threaded and coupled random 21-foot sections. A complete line of CARLON plastic fittings incorporating standard I.P.T. is available to permit complete corrosionproof plastic installations as well as connection to fixtures and previously installed metallic lines.

At present, raw material shortages are limiting the production of certain types of CARLON pipe. Every effort is being made to overcome this problem and to meet the need for CARLON . . . the first real pipe that is plastic.

CARLON CP 218-CP

CARLON PRODUCTS CORPORATION

10132 Meech Avenue • Cleveland 5, Ohio

In Canada: Micro Plastics, Ltd., Acton, Ontario

There's No Catch in It!

What is it? It's a plastic model of the amazing new "Bladeless" impeller developed by Fairbanks-Morse pump engineers for Figure 5400 solids-handling pumps.

Why no catch in it? Because, unlike conventional impellers, there are no blades to catch and hold fibrous trash. It makes possible a truly "non-clog" pump. The chain in the illustration follows the water path through the single channel impeller and shows clearly that there's no "catch" possible. And that's important from a maintenance and operating cost angle because the ordinary solids-handling pump often must be dismantled as much as twice daily to clear clogged impellers.

This new advance in pump design is typical of the constant research and product improvement that make possible the high quality and efficient performance of all Fairbanks-Morse products. Fairbanks, Morse & Co., 600 South Michigan Avenue, Chicago 5, Illinois.

Fairbanks-Morse Figure 5400 solids-handling pump, featuring the "single channel" impeller. Phantom view of impeller clearly shows that there are no "blades" to catch or damage pumped material.

FAIRBANKS-MORSE,

a name worth remembering

PUMPS • SCALES • ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES • DIESEL, DUAL FUEL AND GASOLINE ENGINES • HOME WATER SERVICE EQUIPMENT FARM MACHINERY

Specify CONCRETE PIPE

for Long Service at Low Annual Cost

FROM coast to coast leading sanitary engineers specify concrete pipe for sewer lines because it meets all essentials of long, dependable, economical sewerage service:

1. **Ample strength** to resist severe impact and to sustain heavy overburdens.
2. **Maximum carrying capacity** and high **wear resistance** to abrasion caused by suspended matter in high velocity flow because of its smooth interior finish and clean, even joints.
3. **Minimum infiltration and leakage** because of tight joints and uniformly dense concrete.
4. **Durability** to render long years of heavy-duty service. This means real *low-annual-cost* economy.

Concrete pipe lines for drainage, sanitary sewers and waterlines have demonstrated their superiority in thousands of installations all over America. Many of these lines have served under the hardest usage for half a century and more.

Concrete pipe serves economically because of its moderate first cost, long life and low upkeep. These factors guarantee *low-annual-cost* service—the true measure of pipe line economy.

Sanitary sewer being laid in Ridgewood, N. J., a suburban community of 15,000 near New York City.

AMERICAN CONCRETE PIPE ASSOCIATION

228 NORTH LA SALLE STREET, CHICAGO 1, ILLINOIS

Chemical and Physical Properties of Fused Alumina Filter Plates

Norton Alundum® porous plates, unaffected by acid, neutral and slightly alkaline liquors, combine uniform porosity with great strength.

Made of fused alumina, fired to at least cone 12, Norton Alundum porous plates are relatively unaffected by acid, neutral and slightly alkaline liquors. The high alumina glass bond may be affected by strong and hot sodium and potassium hydroxides and by hydrofluoric acid. The following table shows the results of solubility tests under exacting conditions with standard 12" x 12" x 1" Norton Alundum porous plates.

SOLUBILITY TESTS

Solution	Strength in Percent	Percent, Cumulative Loss — Same Plate Alternating Hot and Cold		
		Loss at 10 Days	Loss at 20 Days	Loss at 30 Days
		75 Hrs. at 85-100° C. 169 Hrs. at 20° C.	131 Hrs. at 85-100° C. 349 Hrs. at 20° C.	192 Hrs. at 85-100° C. 328 Hrs. at 20° C.
Phosphoric Acid	85.00	.373	.522	.654
Phosphoric Acid	42.50	.290	.362	.394
Sulphuric Acid	96.00	.326	.444	.488
Sulphuric Acid	25.00	.391	.494	.578
Nitric Acid	70.00	.149	.187	.232
Nitric Acid	22.00	.130	.167	.234
Hydrochloric Acid	35.00	.354	.528	.674
Hydrochloric Acid	20.00	.292	.352	.397
Hydrofluoric Acid	.25	.602	.644	.644
Sulphuric Acid Nitric Acid	1/5 of 96.00 1/20 of 70.00	.188	.318	.388
Ammon. Hydroxide	28.00	at 20°C. .046	at 20°C. .057	at 20°C. .062
Sodium Hydroxide	10.00	.937	1.453	2.302
Calcium Hydroxide	Sat. Sol.	at 20°C. .032	at 20°C. .046	at 20°C. .062
Ammonium Chloride	10.00	.041	.053	.076
Zinc Chloride	10.00	.084	.123	.142
Zinc Chloride	5.00	.032	.044	.052

NOTE Only in the case of sodium hydroxide were edges of plates affected. A slight rounding was noticeable as was to be expected.

UNIFORM PERMEABILITY

Because of Norton's patented "Controlled Structure" process, Alundum porous plates meet extremely rigid specifications for uniform permeability. The size and number of open pores determine permeability. The following table gives approximate pore sizes for different porosities and permeabilities. Permeability is given in cubic feet of air passed per minute on a dry plate 12" x 12" x 1" under 2" water pressure.

Permeability	Percent of Pore Space by Volume	Avg. Dia. of Pores
4 cubic feet	36	0.09 mm.
20 cubic feet	35	0.21 mm.
40 cubic feet	34	0.30 mm.

®Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

GREAT STRENGTH

The following table of tests on standard Alundum 12" x 12" x 1" porous plates of various permeabilities indicates the ability of these plates to operate under high pressures and to resist breakage and chipping due to handling and cleaning.

Average Permeability of Dry Plate, cu ft/min/sq ft/ in. thick /at 2 in. Water Pressure	Average Modulus of Rupture, psi		Breaking Load when Wet Plate is Supported on Four Sides with ½" Bearing	
	Dry	Wet	Ft. of Water	#/sq. in.
121.0	1670	1465	97	42
80.9	1950	1685	110	48
37.8	2684	2235	147	64
16.9	3045	2644	175	76
4.1	3770	3716	246	107

GET BULLETIN 140

All of the foregoing data, as well as detailed installation and cleaning instructions, are contained in a highly informative 16 page bulletin. To get it, contact your nearby Norton representative or write direct. NORTON COMPANY, 822 NEW BOND ST., WORCESTER 6, MASS.

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

Special REFRACTORIES

Canadian Representative

A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

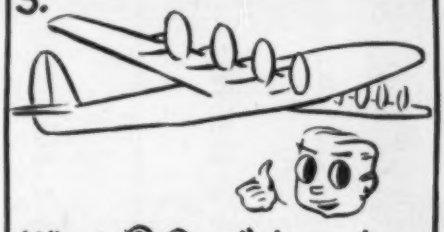
1.

What ℅℅ were the sharp-shooters of yesteryear?

2.

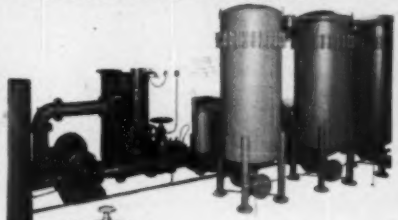
What ℅℅ were "big shots" at Gettysburg?

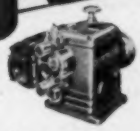
3.



What ℅℅ are "throwing their weight around" these days?

4. What ℅℅ make BOTH chemical feeders and diatomite filters?





Answer:

% PROPORTION ℅℅ %

Whether you "kill" your waterborne disease "enemies" with chemicals or "stop them dead" with filtration, %Proportioneers% is the best source for equipment to do the job. %Proportioneers% Chem-O-Feeder is well recognized for its versatility. You can use it for feeding hypochlorites, fluorides, coagulants, polyphosphates. The Pur-O-Cel Diatomite Filter, another important weapon against contamination, is so efficient it even filters out amoebic dysentery cysts.

Yes, %Proportioneers% is armed with the only "double-barreled shotgun" in the business. Mail coupon for complete details.

%PROPORTIONEERS, INC.%
350 Harris Avenue
Providence 1, Rhode Island

Please send me Bulletins SAN 7 and 1800.

Name.....

Company.....

Street.....

City..... State.....

Answers: 1. Fusileers 2. Cannoneers 3. Bombadeers

4. % PROPORTIONEERS, INC. %

To a man who'd like to rid his town of garbage . . . forever!

There's a growing trend, clear across the country, towards making whole cities and communities *permanently garbage-free.*

This is being done through evet increasing municipal sponsorship of the revolutionary General Electric Disposall®—which eliminates garbage by shredding food-wastes into tiny particles and washing them away, as *processed* food-wastes, to septic tank or sewer.

Because the advantages of garbage-free homes and streets are obvious—in improved public health and cleanliness, and reduced sanitation costs—some of you may already have discussed the possibility of adopting the G-E Disposall method as a civic project in *your* community.

With nearly 20 years of experience in creating and developing the food-waste disposer, General Electric is in an excellent position to give you the benefit of its technical and practical knowledge in this field.

Why not—for a start—take full advantage of our files of specialized information? Copies of the booklets and reprints detailed on the right are immediately available at no cost or obligation to you. Simply write General Electric Company, Dept. W9. Bridgeport 2, Connecticut.

Send for the free, non-technical, consumer booklet on municipal installations: "Dad—what was Garbage?"

"Dad—what was Garbage?"

SEND FOR THIS SPECIALIZED INFORMATION!

1. Booklet—*"The Use of General Electric Disposalls® with Private Septic Tank System."*

2. Booklet—*"Technical Data on Food-waste Disposal Through the Public Sewage System."*

3. Reprints of articles by leading authorities on sewage and garbage disposal problems.

4. Reprints of articles giving details of the garbage elimination plan in Jasper, Indiana—where approximately ¾ of all homes already have G-E Disposalls installed.

G-E DISPOSALL

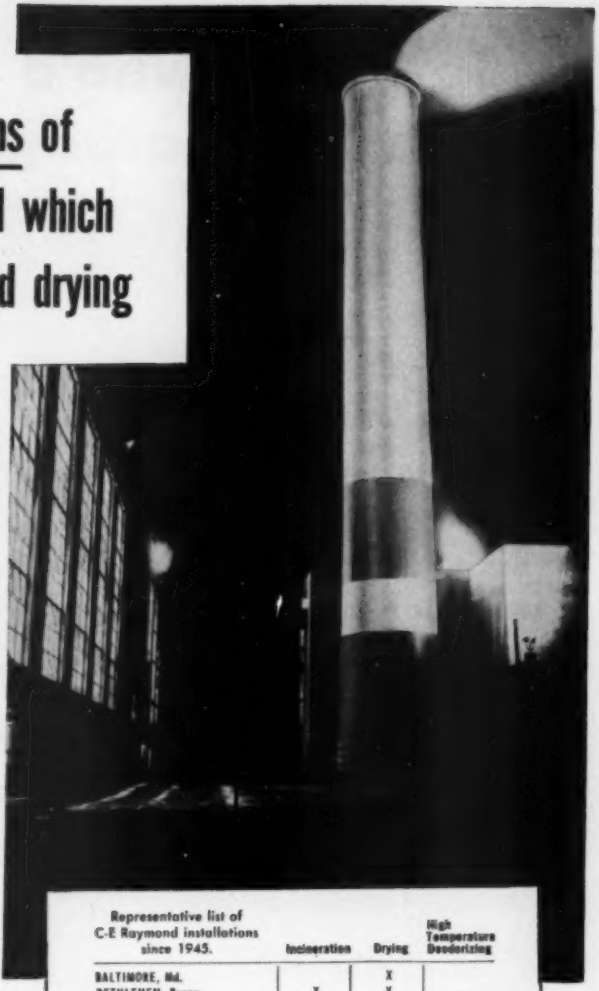
CONVERTS FOOD-WASTE TO SEWAGE—ELIMINATES "GARBAGE"

Trim and specifications subject to change without notice.

You can put your confidence in—

GENERAL ELECTRIC

the only proven means of Sewage Sludge Disposal which combines incineration and drying



As will be seen by the list at the lower right, there have been seven major installations of C-E Raymond Systems in the last five years which combine the two usual disposal methods . . . drying and incineration. The C-E Raymond System usually provides for high temperature deodorizing employing preheater equipment to save fuel and assure low stack temperatures.

C-E Raymond System installations are in service in virtually all parts of the country, meeting the varying requirements of both large and small communities. They are flexible in layout, highly efficient and thoroughly reliable; they provide for maximum utilization of waste heat.

A major reason for the success and widespread acceptance of C-E Raymond Systems is the exceptional background of experience represented in their design and manufacture. The Raymond Division has long been a recognized leader in the fields of grinding and drying, and Combustion Engineering—Superheater, Inc. has enjoyed similar standing in the combustion and heat recovery fields. The services of C-E specialists are available to assist you in finding the best solution to your sludge disposal problem.

B-464

Industrial sludges a problem?

C-E Raymond Flash Drying and Incineration Systems have been the answer for others. Write for information.

Representative list of C-E Raymond installations since 1945.	Incineration	Drying	High Temperature Deodorizing
BALTIMORE, Md.		X	
BETHLEHEM, Penna.	X	X	
BLOOMSBURG, Penna.		X	X
CHICAGO, Ill. (W. Southwest)	X	X	
FOND DU LAC, Wis.		X	X
HOUSTON, Texas		X	
LOS ANGELES, Calif.	X	X	X
SAN DIEGO, Calif. (Extension)		X	X
SAN FRANCISCO, Calif.		X	X
SCHENECTADY, N. Y.	X	X	X
SHEBOYGAN, Wis.		X	X
WATERBURY, Conn.	X	X	X
COLNE VALLEY, England	X	X	X
RECIFE, Brazil		X	
WASHINGTON, D. C.	X	X	
WYOMISSING VALLEY, Penna.		X	X

C-E

COMBUSTION ENGINEERING—SUPERHEATER, INC.

FLASH DRYER DIVISION

1315 North Branch Street — Chicago 22, Illinois

Western Office: San Fernando Bldg., Los Angeles 13 — Eastern Office: 200 Madison Ave., N. Y. 16

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

Streamway POWER FOR PUMPS

WITH THE NEW VERTICLOSED

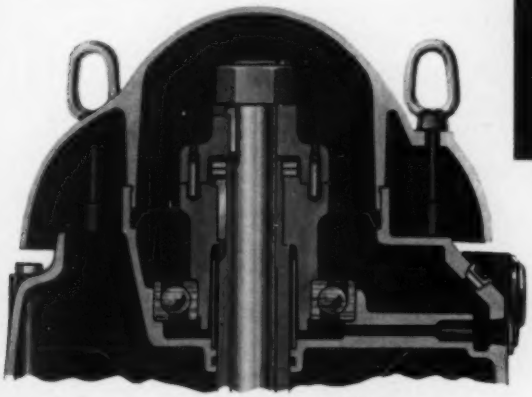
U. S. MOTOR

This amazing new motor involves much more than attractive external appearance. It introduces an entirely new conception of pump motor refinements. The deep well pump you select and its U. S. Verticlosed Motor become fully integrated both in structure and function.

The Verticlosed Motor is the progressive result of designing a motive unit for a specific purpose—to *most economically* power a deep well turbine pump.

You can order this new motor as an integral part of your new pump without paying increased price. Or you can replace your present pump motor without paying for expensive fittings.

Whatever pump you choose, specify the U. S. Verticlosed Motor. You'll save on power; you'll benefit by real economy through many years of extra pump life.



Detail showing Reg-U-Lube Oil Flow

Improved lubrication with

REG-U-LUBE and LUBRIFLUSH systems

Because pump motors must continuously operate for long periods under heavy load, lubrication must be positive—never failing. In the larger size Verticlosed Motors the proven Reg-U-Lube system provides a gravity-fed oil flow which keeps bearing lubricant at normal temperature. In Verticlosed Motors of under 25 h.p., 1800 rpm, the perfected Lubriflush system permits thorough flushing of old devitalized grease.

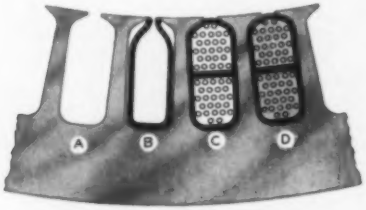
AMERICA'S MOST DYNAMIC PUMP MOTOR

(See next page)

THESE ADVANCED U. S. MOTOR FEATURES INCREASE THE LIFE AND SERVICE OF DEEP WELL PUMPS

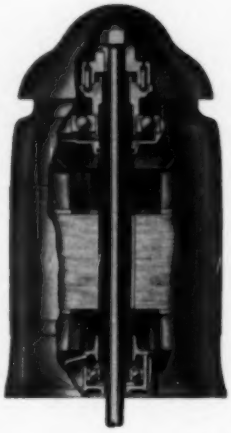
To give the maximum service, a deep well turbine pump must be powered by a motor free from vibration, free from excessive bearing stresses, ever-cool during long periods of continuous operation, and high in efficiency. The new U. S. Verticlosed Motor meets and exceeds these requirements. Moreover it offers many advanced features found in no other motor because it has been designed for one specific service—the powering of deep well turbine pumps. More than forty years of constant progress are reflected in its incomparable design.

U. S. Vis-O-Lube Oil Gauge



ASBESTOS-PROTECTED WINDINGS

Asbestos *cannot* carbonize. It safeguards U. S. motor windings from internal heat. The above drawing shows method of application. *(A)* Empty stator slot. *(B)* Insulating sheet asbestos. *(C)* Conducting wires in asbestos cell. *(D)* Complete asbestos impregnation around each wire.



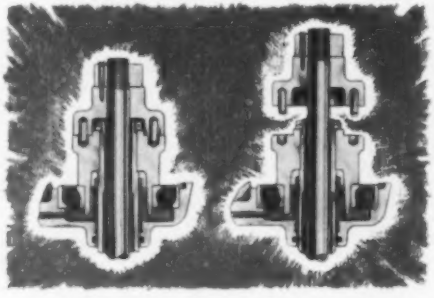
Showing the hollowshaft principle conceived and patented by U. S. Motors. The flexible coupling is eliminated, and pump head thrust bearings relocated in the motor.

FULLY VISIBLE OIL GAUGES

No more unsightly, protruding oil gauges. The new U. S. Vis-O-Lube gauges are set within the motor, fully visible at a distance. Large, clear Lucite windows reveal oil content.

NORMALIZED CASTINGS

Fine precision parts such as used in giant telescopes, artillery guns, angle blocks, etc., are invariably *normalized*, to prevent warpage and stresses. So are U. S. motor castings; therefore bearings are always in perfect alignment, insuring longest life.



REVERSE PROTECTION CLUTCH

By using the famous U. S. hollowshaft, the pump shaft is connected with the motor shaft through this reverse protection clutch. The pump shaft cannot become unscrewed by torque reversal.

Whatever the pump, make U. S. Motor a "must"

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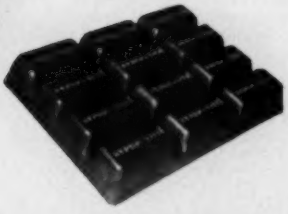

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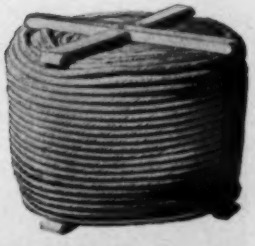

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PROGRESS REPORT

Philadelphia's Campaign for CLEAN WATERS

New 125,000,000 gallon-per-day Northeast Sewage Treatment Works, built to free Delaware River of pollution, utilizes over 100 G-E equipments

Over the years, almost 85 per cent of Philadelphia's sewage, currently estimated at 350 million gallons per day, has been poured untreated into the nearby Delaware and Schuylkill Rivers. Public and official displeasure with the resulting stream pollution led in 1945 to the adoption of a program for the completion of the sewage treatment system to serve the entire city area.

The first of three plants in the $60 million system, which is scheduled for completion in 1953, was placed in operation in April of this year. Designed for the future to serve the area's estimated 1970 population, the Northeast Sewage Treatment Works will abate pollution of the upper Delaware River.

G-E equipment in the new plant includes unit substations, switchgear and control, and over 75 drive motors. A less obvious but most important contribution to the effectiveness of the works has been G-E Application Engineering: fitting power-distribution and drive equipment to the job requirements.

General Electric helps make your pollution-control program a success in two ways:

1. Aids in winning public support through the G-E packaged program "Modern Sewage Treatment" including the full-color sound movie *Clean Waters.*
2. Assists your engineers or consultants in the formation of electrical plans.

To take full advantage of these services, be sure to contact your G-E representative early in the planning stage. *General Electric Company, Schenectady 5, N. Y.*

Forty-eight G-E ½-hp induction motors power the sludge collector mechanisms in these final settling tanks. G-E 1-hp motors perform a similar function in the primary tanks.

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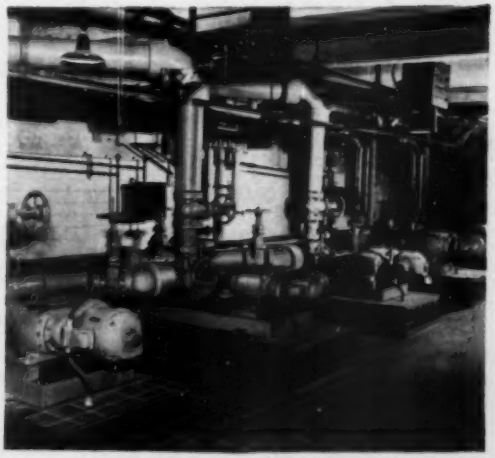
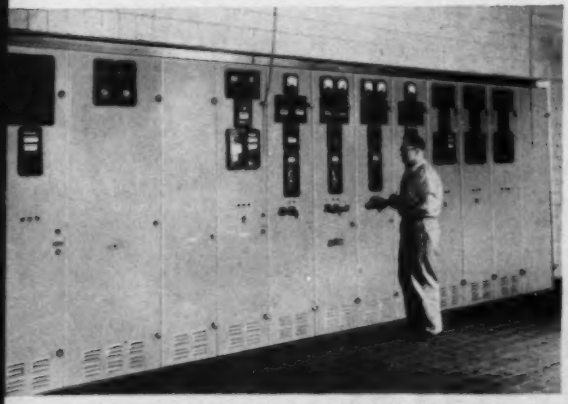
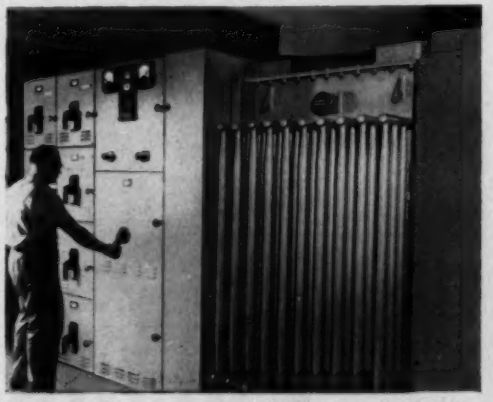


Three G-E Tri-Clad* 5-hp motors in foreground drive pumps which transfer sludge from primary tanks to heaters. In background, two G-E 7½-hp motors drive pumps which move warm sludge to digestor tanks after heating.

Northeast Sewage Treatment Works operates on the modified-activated-sludge process. Completion of Southeast and Southwest plants, will bring under treatment all sewage and industrial waste entering sewers in the Philadelphia area.



G-E metalclad switchgear controls 2300-volt power to three large motors which drive blowers supplying compressed air for the aeration tanks.



This G-E 500-kva, two-phase, 2400/240-volt unit substation is one of two in the blower house which supply power to sludge-pump and collector-mechanism drives.

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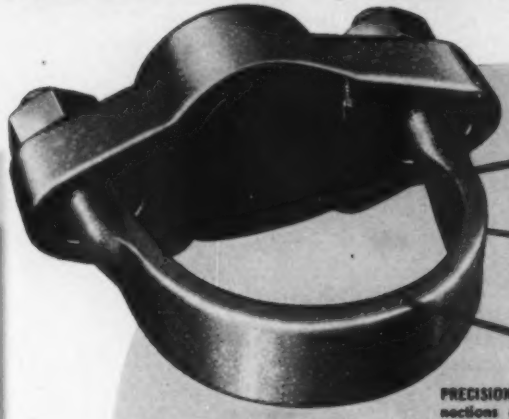

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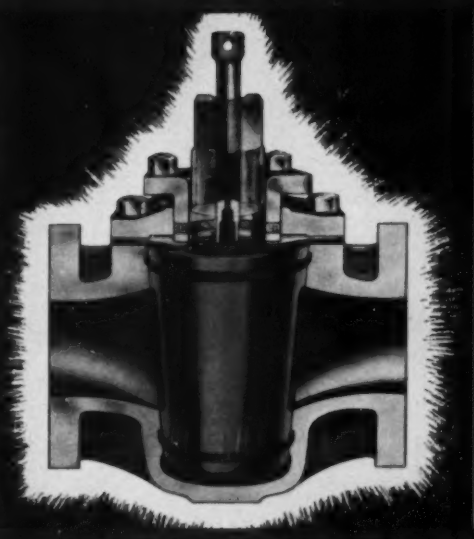

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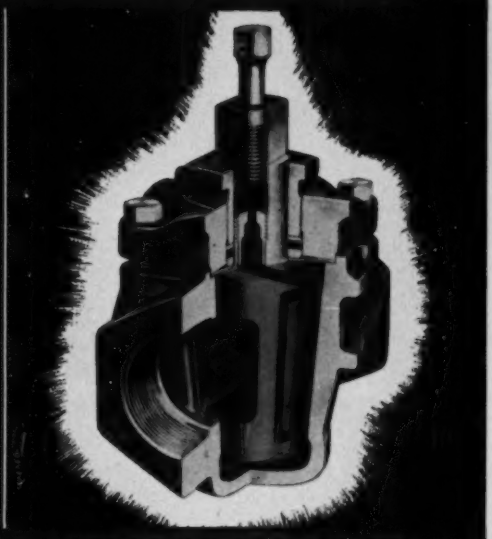

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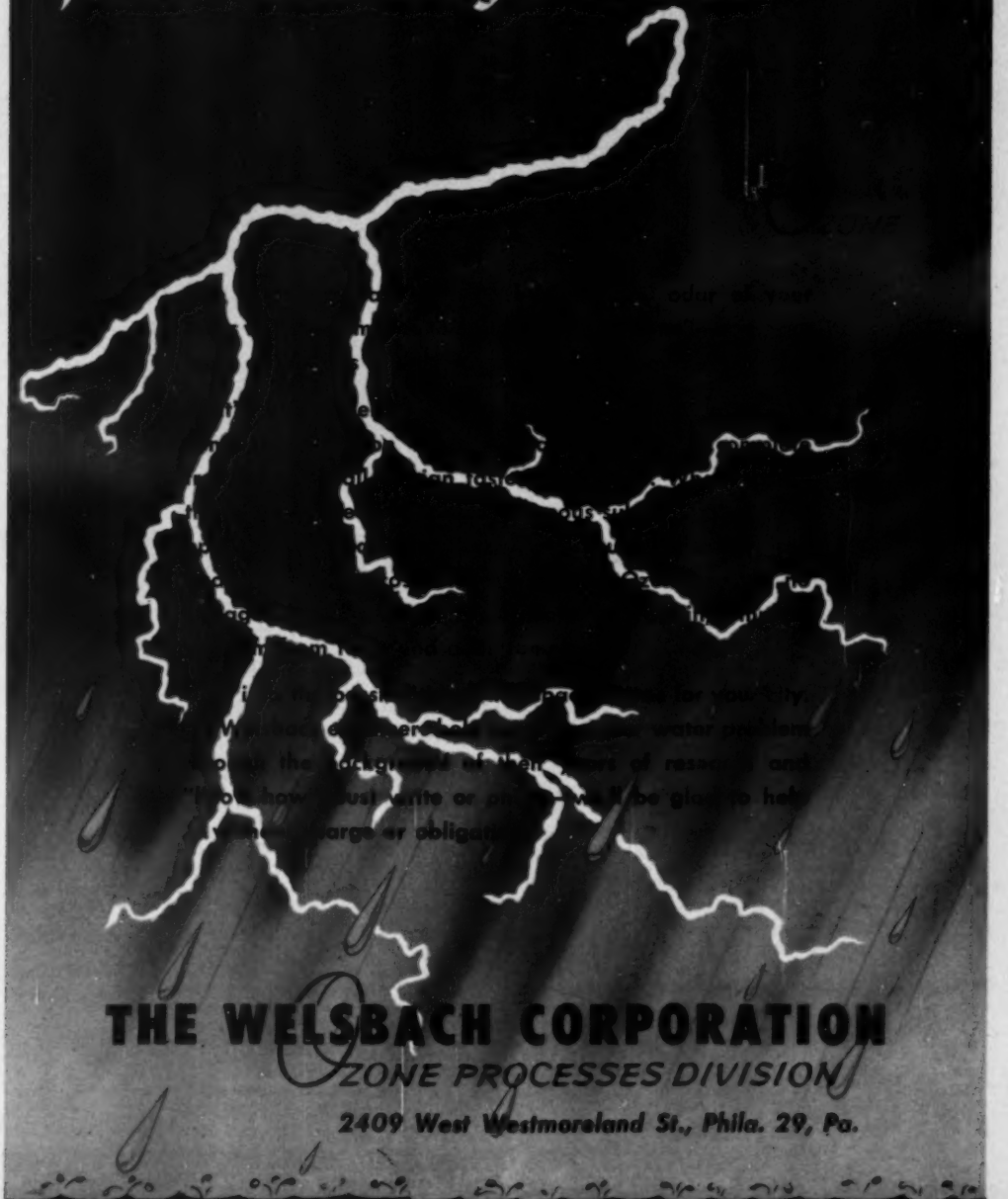

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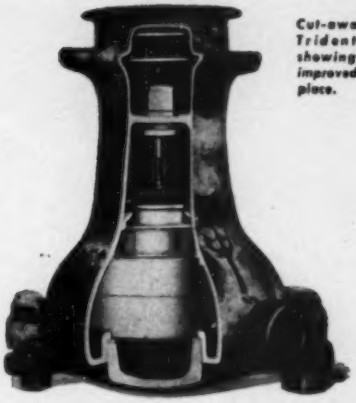

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WATER & SEWAGE WORKS

VOL. 98, NO. 9 • A GILLETTE PUBLICATION • SEPTEMBER 1951

UNIT WELL STATIONS—typical of others comprising Madison's water supply. That on left is equipped with aerator atop reservoir.

New Standpipe At Madison, Wis.

Rounds out combination of elevated and ground-storage on Madison System

by LEON A. SMITH, *Sup't of Waterworks and Sewerage, Madison, Wisconsin.*

THE load factor of a modern water utility is very poor. This is because consumers demand water at vastly varying rates during the various parts of the day. More water is used in the daytime than at night, and on Monday the pumpage is generally 50% greater than on Sunday. In hot, dry summer weather the average daily consumption may be twice that during the winter months. On the other hand, the most efficient operation would consist of pumping continuously at a uniform rate under a constant head; or, else, doing most of the pumping during off-peak current rates. To do either, ample storage is necessary. In addition, it is extremely desirable that uniform pressures be maintained in the distribution system so that centrifugal pumps can operate at the high points of their efficiency curves.

The problem of storage in Madison is extremely important because of the city's topography, and the type of supply. The city has an area of ten square miles and is fifteen miles long, so that the average width is only 1.5 miles. This is due to the fact that Madison is located on an isthmus between two lakes, which is only 3,000 feet wide at its narrowest point. The city fans out in both the eastern and western portions and a considerable development has taken place south of the smaller lake. The water supply is obtained from twelve deep wells. Because of the interference between wells, for the most part they are located a mile or more apart. The result is that an entire circuit of the wells involves travelling approximately twenty-five miles. (Incidentally, two new wells have recently been drilled—one in the eastern portion of the city and one in the western portion—both of which will be in service next year, making fourteen in all.)

Four of the wells are adjacent to the Main Pumping Station in the central portion of the city and furnish water to the Main Station. All of the wells are pumped by electricity. At the Main Station the water is repumped from the surface collection tanks into the distribution system by motor-driven pumps in the summer and by steam-driven pumps in the winter. This is due to the fact that the Water Department furnishes steam for heating several city buildings, including Central High School, Vocational School, City Hall and Library, and it is more economical to pump water by steam from the Main Station during the winter months, as the exhaust steam can be used for heating.

The other eight wells are unit wells, three of which are located in the eastern portion of the city, three in the western portion and two in the southern area. They are complete pumping stations, including well, pumphouse, pumping equipment and surface reservoir in each instance, and all are automatically operated. Motor-driven deep well pumps are used to pump water from the wells into the surface reservoirs and motor-driven centrifugal pumps deliver the water from the station surface reservoirs into the distribution system. The entire distribution system is interconnected so that

(Photo courtesy Chic. Bridge & Iron Co.)

WATERSPHERE of Madison is certainly no eye-sore. Capacity of 30 ft. sphere on 100 ft. tower is 100,000 gals.

in case of failure of any of the unit wells, the other unit wells still in service can furnish water to any portion of the city.

About the Madison System

The population served is approximately 110,000, of which 100,000 live in the city of Madison. The others live in the adjacent suburban areas. Water is furnished to three villages, one east of the city, one west and one to the south, as well as to a portion of four towns adjacent to the city limits. The daily pumpage is about 12,000,000 gallons. The twelve wells have a total capacity of 25,000,000 GPD, thus providing an ample supply to meet peak and emergency conditions. Duplicate pumping equipment has been provided at the Main Pumping Station. The number and location of the unit wells provides the necessary factor of safety, so that duplicate equipment at these locations would be uneconomical and can not be justified. An adequate stock of repair parts, however, is kept on hand.

The Madison Water Department was established in 1882, operating by direct pressure. However, in 1890, the necessity of elevated storage became evident and a 50,000 gallon elevated storage tank was constructed.

This was adequate for a few years but, in 1908, it was felt necessary to build a 1,000,000 gallon ground storage reservoir. This reservoir was built near the Main Pumping Station. In 1918 a 1,500,000 gallon addition to this rservoir was built and, in 1925, a 600,000 gallon reservoir was built at one of the wells serving the Main Station, about 3,000 ft. from it. The present ground supply storage, therefore, is in excess of 4,000,000 gallons, with nearly 1,000,000 gallons additional in the surface reservoirs at the unit wells. All of these are reinforced concrete structures, covered to prevent contamination from airborne bacteria or other contaminating material.

Need for Elevated Storage Became Apparent

About 1925, it became apparent that elevated storage was desirable because the pumps had to operate under a rather high direct pressure. This was reasonably satisfactory with steam pumps, but with the advent of electrical centrifugal pumping equipment satisfactory efficiencies were not being obtained. In 1927, a 6,000,000 gallon concrete high-service reservoir was built on a hill in the western portion of the city. This hill is 200 feet high and when the reservoir is full the static pressure at the Main Pumping Station is 86 pounds p.s.i. It is a circular structure, 205′ in diameter and 30′ deep. It has a concrete roof over which there is an earth fill which has been sodded, making a nice open area which—with the adjacent ground—is a waterworks park.

In the street, in front of the high-service reservoir, there is a 20″ pipe connecting to the northern portion of the distribution system and a 12″ pipe connecting to the southern portion. A single 12″ connection was made to a valve pit. In this valve pit the connection is divided into two lines—an inlet pipe and a discharge pipe. These have been provided with the necessary check valves so that all of the water enters one side of the reservoir and flows out of the other side. Circulation is insured because the reservoir has a partition wall through which there is a valved pipe connection at the opposite end of the partition wall from the inlet and discharge pipes. In case of necessity for repair, one side of the reservoir can be shut off and the other side permitted to remain in service.

The 6,000,000 gallons of "elevated storage" is reasonably ample, as far as high-service storage capacity is concerned, but it is located about three miles west of the Main Pumping Station and no elevated storage had been provided in the eastern part of the city. During the last four or five years extremely large residential developments have occurred in this area which is so far from the concrete reservoir that the unit wells in the eastern part of the city operated practically under direct pressure. This means that the pressures varied considerably and it was difficult to operate the system so that the centrifugal booster pumps at the unit wells would operate at peak efficiencies. It was therefore decided to augment the storage capacity by providing high-service storage in the eastern portion of the city. The highest hill in this area, reasonably close to the distribution system, was 100′ high. It was recognized that a substantial storage capacity would be necessary. In order that the flow line in the new storage reservoir be the same as that in the concrete reservoir, it would have to be 100′ high above the 100′

elevation of the hill above the Main Pumping Station.

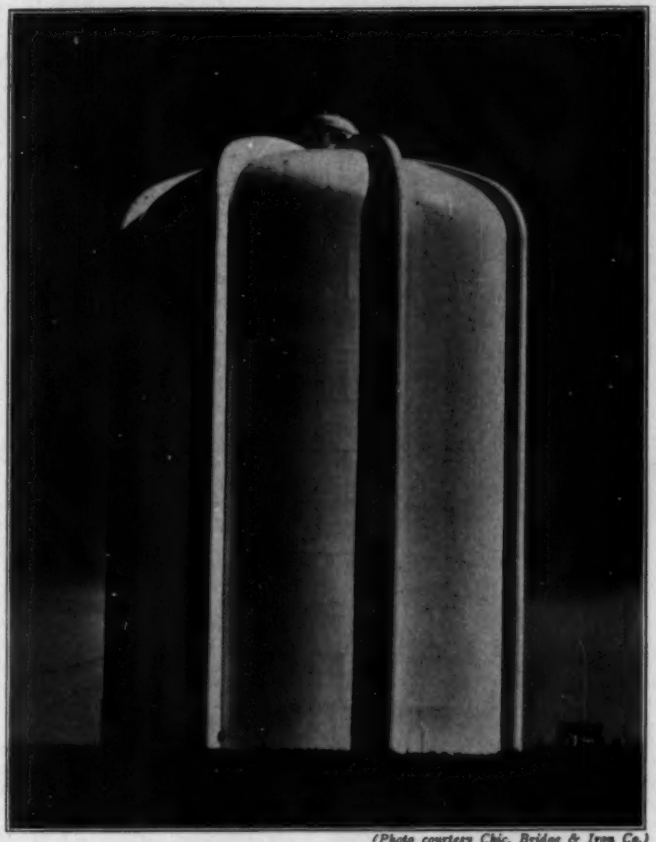
A Study Results in Standpipe As Choice

Two alternatives were studied. One was the construction of a 1,000,000 gallon elevated tank on a tower. The estimated price of this was $132,000, exclusive of foundation. The plans called for 400 cubic yards of concrete in the foundation which, estimated at $20 per cubic yard, would have made the cost of the foundation $8,000. The 1,000,000 gallon tank, therefore, would have cost $140,000. The other alternative was the construction of a 3,000,000 gallon standpipe, which was the final choice. The cost of the standpipe, including foundation, was $167,000. All other items, such as pipe connections, altitude valves and appurtenances of that nature, would be the same in each case.

The new standpipe is 73′ in diameter and 100′ high, electrically welded. The steel plate in the cylinder varies from 2″ in thickness at the bottom to ¼″ at the top. The floor is ⅜″ thick. There are six pilasters, each 30″ wide, consisting of a half-circle, with two tangential pieces 1′6″ long, welded to the standpipe wall. The pilasters are curved to support the roof and end at the center of the roof, where a small cupola was built.

The inlet pipe is a 12″ cast iron line, carried in under one of the pilasters and discharging at a height of approximately 100′ above the ground. The outlet pipe is a 12″ pipe through the floor of the standpipe, with an elbow at the bottom and a pipe line extending to a point outside of the structure where a valve chamber is located.

Obviously, in a structure of this type the soil itself must bear the weight. In order to provide a uniform foundation, a ringwall was built. This is a cylinder 73′ in diameter and 1′6″ thick, the depth being 6′. It is made of heavy reinforced concrete, the top flush with the surface of the ground. In order to insure a uniform bearing, the upper 2′ of the soil inside of the ringwall was excavated. The lower 1′6″ was filled with large sized crushed stone, thoroughly compacted. A 4″ layer of oiled sand was spread over the top of the crushed rock and finished with a 1″ layer of dry sand, flush with the top of the concrete. The standpipe was built directly on this sand and was centered on the center of the ringwall. Lugs were welded to the lower plates so that the settlement could be observed. When the tank was filled the settlement was approximately ¼″, with no noticeable variations.



(Photo courtesy Chic. Bridge & Iron Co.)

NEW STANDPIPE of Madison rounds out the effective distribution of storage—diam. 73 ft.; height 100 ft.; capacity 3,000,000 gals.

In other words, the standpipe is practically exactly vertical.

Storage capacity, to be completely effective, must be available at all times, even when there are electric outages. The upper 1,000,000 gallons in the standpipe would be just as readily available as if it were in an elevated tank, but the lower 2,000,000 gallons would not be at sufficient elevation to be available without pumping. For this reason, a standby gasoline engine was installed at the site of the standpipe. One of the unit wells, which has recently been drilled, was located at the site of this standpipe, so that the standby gasoline pump could be installed in the same pumphouse which serves the deep well pump. The cost of the gasoline driven standby unit, including complete installation and pipe line connections, will be less than $5,000. Adding the $5,000 for this standby unit, the total cost of the improvement will be $172,000, for which 3,000,000 gallons of effective storage is obtained. This amounts to $57,300 per million gallons. The cost of the storage in the 1,000,000 gallon elevated tank would have been $140,000 per million gallons, a ratio of nearly 2½ to 1 in favor of the standpipe. In addition to this, there is the added security which the 2,000,000 gallons of extra storage between ground level and 66′ above will provide in case of emergency.

The deep well pump at the site of the standpipe will pump directly into the standpipe and will be automatically started and stopped by the changing elevation of the water in the standpipe. The standpipe has a capacity of 30,000 gallons per foot of depth and the water level in the standpipe will be permitted to drop 5 ft. before the deep well pump starts. An auxiliary connection has been provided so that the deep well pump can pump directly into the distribution system if the standpipe is out of service for any

ERECTION progress picture of the 3 mg. Monona Standpipe, equipped with cathodic protection.

reason. This well has been developed so that the available capacity is 3,000,000 GPD. However, the pump which will be installed will have a capacity of only 1500 GPM, or slightly over 2,000,000 GPD. This is done because this quantity of water will be sufficient to serve this area for the next five years and it is more economical to pump at a lower head for this period of time, and replace the pump when necessary, than to install the larger size pump at the present time.

Madison's "Watersphere" Amongst Earliest

There is an area in the western portion of the city which is too high to receive satisfactory service from the normal pressure in the distribution system. This area is served by three booster pumps, with capacities of 300, 500, and 1500 GPM respectively. These booster pumps are automatically operated by progressively cutting-in and cutting-out as the demand varies. Under normal conditions at night, the 300 GPM pump furnishes a sufficient amount of water. When the pressure drops, the 500 GPM pump is automatically started and the 300 GPM pump stops. If the pressure still drops, the 300 GPM pump again comes on the line. If both are insufficient, the 1500 GPM pump cuts in and the other two are stopped and, under emergency conditions, such as a large fire, all of the three pumps automatically go into operation.

When the system was originally installed, these booster pumps operated under direct pressure. This, of course, was unsatisfactory and uneconomical. So in 1941 a small elevated tank was built in this high-level area. This was of the type known as a "watersphere" and consists of a spherical tank 30′ in diameter, having a capacity of 100,000 gallons at an elevation 100′ above the ground. (Quite a novel development at the time, this installation was described in an article featured in the Mar. 1941 issue of *Water Works & Sewerage* with the "watersphere" pictured on the front cover.)

The "watersphere" is of welded steel construction and is supported by a riser column on a truncated column base, the over-all height of the entire structure being 140′. An altitude valve has been installed in the base of the "watersphere" to prevent water overflowing. Under normal operation, the water is permitted to drop about 12′ in the sphere, at which time the necessary booster pump starts automatically, cutting out when the tank is filled. This high-level area in the western portion of the city has also developed at a very rapid rate during the last five or six years and the present method of operation has not been completely satisfactory, because a large amount of water has to be withdrawn from the distribution system to supply this area during hot, dry periods. For this reason the second well, recently developed, has been located at the site of the "watersphere." A well unit pumping station and a 100,000 gallon surface reservoir is being provided.

The operating method will be as follows: The deep well pump will discharge into the surface reservoir. The centrifugal booster pump will take suction from the surface reservoir and discharge into the distribution system of the high-level area with the "watersphere" floating on the line. The starting and stopping of the booster pump will be controlled by the height of water in the "watersphere." This will eliminate the necessity of using the three booster pumps originally installed, although they will be available in case of emergency and will probably be used in the wintertime when the demand for water is low.

This well also has a potential capacity of 3,000,000 GPD, but for the present time it will only be pumped at the rate of 1500 GPM, or slightly over 2,000,000 GPD, because this amount of water is more than ample to supply the high-level area at the present rate of demand. To prevent the booster pump from starting and stopping too often a pressure relief valve is being installed between the high-pressure area and the balance of the distribution system so that the excess water can be diverted into the distribution system when desirable.

An Unplanned Test

Recently an interesting test occurred when all of the electrical units were put out of commission by a severe windstorm. The normal pressure in the distribution system in Madison averages 75 pounds, the pressure at the unit wells varying from 80 to 100 pounds, depending upon their elevation and the demand for water. The normal pressure at the Main Pumping Station is 93 pounds and the height of the water in the high-service reservoir and the standpipe is just 200′ above the gauge at the Main Pumping Station. This is equivalent to 86 pounds of pressure. The 93 pounds of pressure is necessary to absorb the friction loss in the distribution system so that the elevated storage facilities can be filled.

When the electric pumps cut out, due to the windstorm, the pressure at the Main Station dropped from 93 pounds to about 60 pounds and then gradually increased until it leveled off to slightly above 78 pounds. This pressure was sufficient to furnish water for all domestic consumers in Madison, although some of the upper floors in four 10-story buildings, located in or near the Capitol Square, were without water temporarily. Fortunately, this outage occurred about 2:30 A.M. on a Sunday morning when the office buildings were not occupied, so that not a single call was received

FOUNDATION ring-wall 1′-6″ thick, filled with oiled sand, supports new standpipe—note heavy reinforcing.

WATERSPHERE, at close range, was amongst earliest of this departure in elevated tank design. In its base, a booster pump station.

because of this outage. The unplanned test supplied proof as to the worth of Madison's elevated storage under such conditions of emergency, even without starting up the standby gasoline engine driven pumps at the new standpipe.

The unit wells in the western portion of the city had, for years, operated at a comparatively constant pressure because of the 6,000,000 gallon high-sevice reservoir. However, the operating pressures of the unit wells in the eastern portion of the city varied tremendously and their efficiency was reduced because of this fact. With the installation of the standpipe, the pressures have been equalized and the efficiency materially increased. There is no question in my mind but that the service life of pumps is longer when they are operated at a uniform pressure under the conditions for which they were originally designed.

Cathodic Protection Provided

Both the "watersphere" and the standpipe have been equipped with cathodic protection. It is our experience that cathodic protection, properly installed and properly operated, is very effective from the standpoint of reducing corrosion.

Both structures, also, have been equipped with blinking red lights, in duplicate, as required by the Civil Aeronautics Authority.

It was recognized that a standpipe 100' high located on a hill 100' above lake level would be a conspicuous structure and therefore should have adequate architectural treatment so that it would not be an eyesore. Various types of architectural treatment were considered, but the final treatment adopted was the installation of pilasters. These pilasters, in addition to adding to the beauty of the structure, served two utilitarian purposes. They support the roof and also provide a location for the inlet pipe, access ladders, electrical conduit and a fluoridation line. A cupola has been installed in the center of the roof, not only to provide a pleasing appearance but also to house the necessary automatic switches for the lighting system. The standpipe is painted white, with Du Pont Du Lux paint, which chalks so that discoloration is washed off during rainstorms.

Whenever the erection of elevated storage is contemplated there are always objections from residents and property owners in the areas adjacent to the proposed site. It is our experience that these objections can be eliminated if structures of pleasing architectural appearance are selected. The "watersphere" design was selected because it was more desirable from an aesthetic standpoint. It is painted olive green to blend in with the sky and trees. Several property owners in the vicinity of the "watersphere" were apprehensive about the safety of a structure of this type. However, this feeling has long been dissipated and houses have been built on all of the lots adjacent to the "watersphere." The site has been developed into a small park which presents an attractive appearance.

We have also eliminated painting the name of the city on these elevated structures, as we believe that it detracts from their appearance. However, arrows have been painted on the top, showing the direction of the airport. These markers do not show from the ground.

The public reaction to both of these structures has been very favorable. In fact, many people have spoken to me with reference to their pleasing appearance, particularly that of the standpipe.

AERO-VIEW, showing locaton of Monona Standpipe. On the narrow strip of land separating Lake Monona (near) and Lake Mendota (beyond) is the central portion and business district of Madison

Vermont Joins New England Water Control Commission

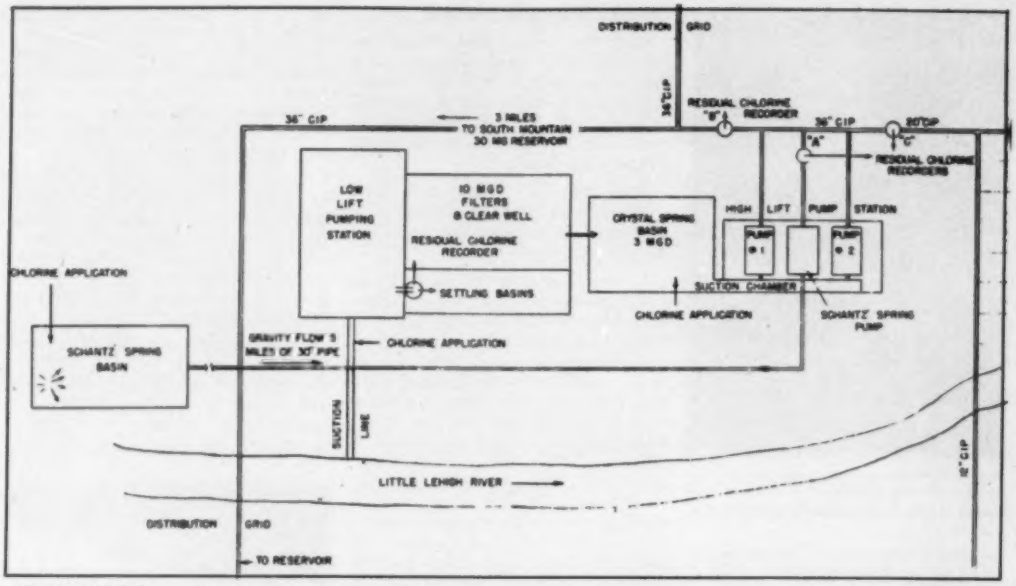
Morris Cohn New Commission Chairman

At the Annual Meeting of the New England Interstate Water Pollution Control Commission held at Chicopee, Mass. on June 8, 1951, Morris M. Cohn, public health engineer of Schenectady, N.Y., was elected chairman of the Commission. During the past year he served as vice-chairman of the Commission and succeeds Dexter D. Coffin, paper manufacturer of Windsor Locks, Conn., as chairman. The new vice-chairman of the Commission is Philip Shutler, Commissioner of the Vermont State Water Conservation Board. Anthony F. Pimentel, Chicopee, Mass., planning board official, was elected Treasurer, succeeding Leo Marceau, Springfield sportswriter who has served in this office since the organization of the Commission.

The New England Commission now includes the states of Conn., Mass., N.Y., R.I., and Vermont. It is all but assured that the New Hampshire legislature will take similar action during the present legislative session.

Joseph C. Knox, Exec. Secy. of the Commission, writes that in the program of clasification of waterways by the Commission, the policy was adopted of holding public hearings in each river valley prior to approval. The first of such hearings will be held on classification of the Pawcatuck River, an interstate stream in R.I. and Conn., a comprehensive study of this River having been made during the past year.

"Science is a first-rate piece of furniture for a man's 'upper story,' provided he also has common sense on the ground floor."—*Oliver Wendell Holmes.*



ALLENTOWN, Pa. purification plant and force mains, showing chlorine application points and residual chlorine recorder locations.

Residual Chlorine Recorder Experiences*

by HARRY J. KRUM, *City Chemist and Bacteriologist, Allentown, Pa.*

TIMES have changed considerably since I first entered the water works profession four decades ago. Then, typhoid fever and dysentery were rampant; chlorination had scarcely been heard of, and chlorination control was definitely in the realm of the future. Today typhoid fever is almost unheard of and chlorination control is an accomplished fact.

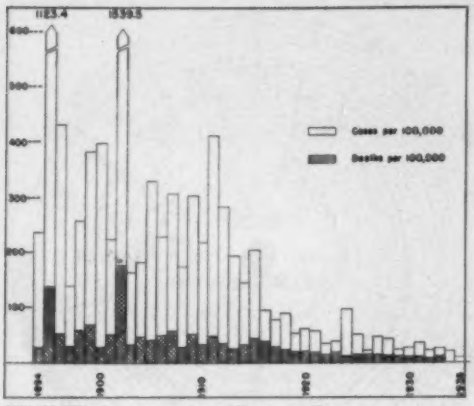
The accompanying bar graph shows the dramatic decrease in typhoid fever incidence from a high of 1539 cases per 100,000 population in 1902 to practically nil today. Typhoid deaths dropped from 174 per 100,000 to zero. By far the greatest factor in this decrease has been water treatment, particularly chlorination, although pasteurization of milk also was a contributing factor to stamping out the disease.

History

In 1910 I was employed by the Allentown Water commission to make one water analysis per month in my own laboratory. I was a pharmacist then. In 1914 the position of City Chemist and Bacteriologist was established and I took over and have been continuously engaged in that work since. The duties of that office

CHLORINE Recorder (by W&T) at Allentown

*Based on remarks made during a panel discussion at the Pa. Sect. AWWA meeting in Pittsburgh, Pa.



TYPHOID fever record at Allentown, Pa.

have included the operation of the water plant and distribution system.

The city began chlorination some time in 1912, before I took over on a full time basis. A solution of chlorinated lime was used in this early treatment. This was fed from a barrel and spigot. It was an entirely unsatisfactory arrangement because the feed was not constant and there was no accurate control. The starch iodide test was used to check the dosage because the ortho-tolidine test had not been devised at that time.

In 1915 we decided at Allentown to buy a gas chlorinator and I personally visited the loft in New York City in which the Wallace & Tiernan organization was doing development work on its first gas chlorinators. On my recommendation, the city of Allentown bought one from them.

I can remember when there were no color standards other than those which we made ourselves. I can remember distinctly when Wolman and Enslow perfected the ortho-tolidine test. I remember that as the next step commercial color standards became available. These standards took various forms, some liquid, some permanent glass, and were very important to us at the time. These advances did not happen overnight but stretched over the years.

At Allentown, for a number of years, we went along with ortho-tolidine and color standards as tools for controlling chlorination. During this period we were learning to distinguish between total chlorine residuals and free chlorine residuals, both as to their function and effect, and as a means of telling them apart and measuring them. The Flash Test and the Hallinan Test were interesting and useful developments for these purposes.

Quite recently we acquired a photo-electric colorimeter. This was a decided step in advance because it eliminated some of the human factors in determining residual by color comparison. Even a color blind man can use this instrument and get reliable second decimal point readings.

Need for Continuous Records

In spite of satisfactory methods of spot testing of chlorine residuals we ran into some taste and odor problems because of erratic chlorinating operations. We needed, and did not have, a continuous record of the results of chlorination in terms of chlorine residuals. Such a continuous record of chlorination was not possible until the Amperometric Titrator and the Residual Chlorine Recorder were developed.

It has been our practice at Allentown to be interested and in close touch with developments in chlorination, and when the Wallace & Tiernan Co. were doing their development work on the Amperometric Titrator and the Residual Recorder, we arranged to have this equipment installed at Allentown for experimental purposes.

From these experiments we first began to recognize that, in spite of the reliability of our spot testing methods, we were obtaining erratic chlorination. The uneven records on the charts of the recorders uncovered a number of conditions in the layout and operations which we had not recognized.

Allentown's Water Supply System

To make some of these things understandable, it is necessary to have an idea of the Allentown plant layout and some of the conditions under which we operate. The water supply system is shown in the accompanying layout diagram. This system is unusual in that we take our water from three different sources. The first source, which the city used, was Crystal Spring (shown on the diagram), which produces about 4 mgd. The next source which the city acquired was Schantz' Spring which produces about 7 mgd. These two springs were the only sources for Allentown until about 1928. Since there were no color or turbidity problems from these sources, the only treatment was chlorination.

In 1928, a 10 mgd. filtration plant was contructed and accessory equipment installed to take water from the Little Lehigh River. Present operations involve using all three of these supplies and mixing them in various proportions, delivering the water through common high-lift pumps.

Schantz' Spring is an open basin holding approximately 2 mil. gal. of water with chlorination applied to the inlet to this basin.

Recorder Results

Chart 1 shows the bleaching effect of sunlight, which we had long suspected but have never been able to prove with spot checks. Our operations log of chlorine residuals showed about 0.3 of a part around the clock.

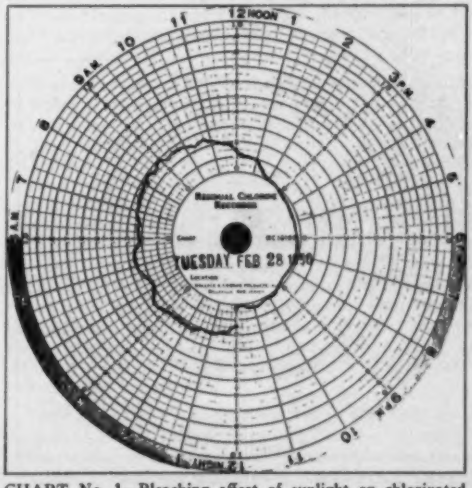


CHART No. 1—Bleaching effect of sunlight on chlorinated water from Schantz' spring

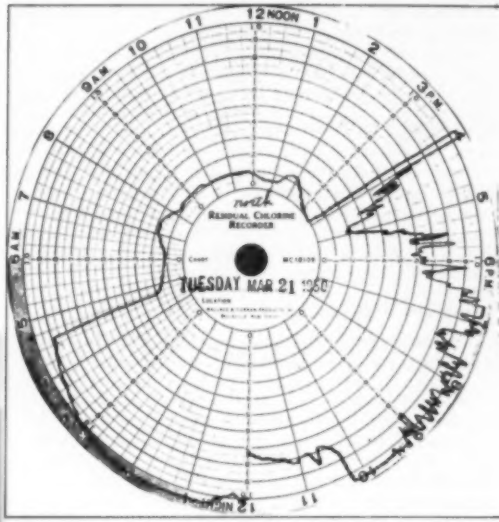


CHART No. 2—Non-uniform distribution of chlorine residuals in north branch because of faulty hydraulics in pumping stations

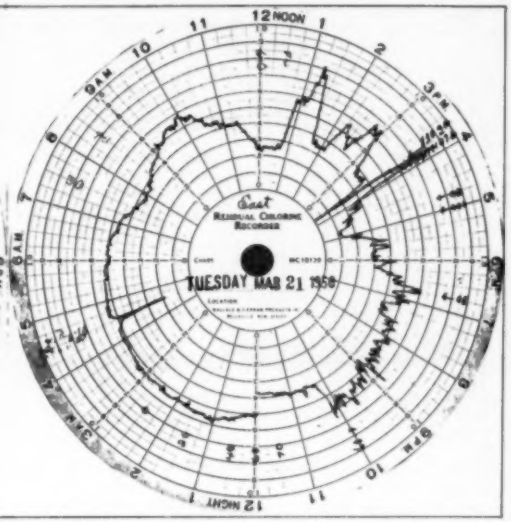


CHART No. 3—Uniform distribution of chlorine residuals in east branch at same time as Chart No. 2.

Actually what happened was that during the night the residual was maintained because there was no sunlight to affect it, but as soon as the sunlight was strong enough to reach the spring basin we began to lose residual due to the bleaching effect. It takes about five hours for the water to travel from Schantz' Spring to the plant and this was apparent from the recorder which shows the bleaching effect definitely on the chart at about 12 o'clock noon. Incidentally, the chart provided us with information on the travel time from Schantz' Spring to the plant. This was one of the first indications that the Residual Recorder could be used to check plant operations.

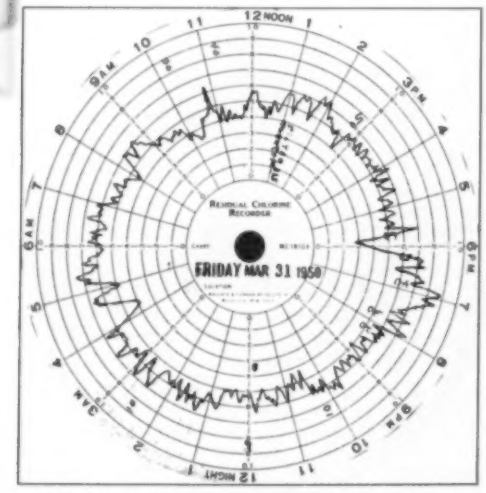


CHART No. 4—Effect of correcting conditions in Charts 2 and 3, accomplished by improved pumping operations and finer feed adjustments.

There was reason to suspect that the distribution of chlorine was not uniform in the delivery system from our high-lift pumps. Residual Recorders were installed at locations B and C to check on this condition. It was our intention, of course, to have enough residual in the water leaving the plant so that it would carry to the far parts of the distribution system, without having such a high residual leaving the plant that the customers close at hand would complain about over-chlorination.

Charts 2 and 3 for recorders at locations B and C tell the story. These two charts indicated to us that with the three different sources with varying demands and with the hydraulic conditions of our distribution system, continuous checking of residuals was needed to be sure that there was sufficient residual throughout the various parts of the system, without overdoing it in a particular part of the system.

Chart 4 indicates that it was possible to take care of the operating difficulties indicated in charts 2 and 3. This correction involved compensating for bleaching due to sunlight and for varying demands in the supplies and other operating conditions which we were able to check. Residual Recorders are equipped with high-low alarms and the operators are trained to find and correct the conditions causing the alarm to sound. This correction usually involves minor changes in chlorinator feed rates at various points of application. For a long while, however, it meant searching for the cause of the deviation.

An Interesting Story

Chart 5 tells a very interesting and unusual story, involving pre-chlorination of water from the Little Lehigh River. About a mile upstream on the Little Lehigh is a fertilizer plant. The fertilizer plant stores a solution of ammonium nitrate in steel tanks. In heavy rains, spill from these tanks eventually reaches the water intake from the Little Lehigh. The recorder on this location was calibrated for free chlorine and when the ammonia came down the river chloramines were formed and we just were not able to add enough chlorine

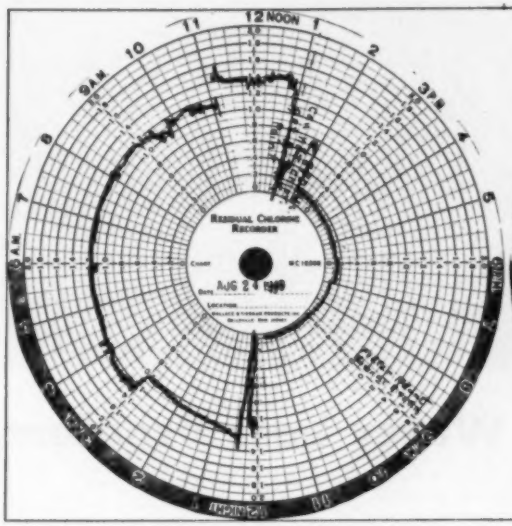


CHART No. 5—Effect of upstream spillage of ammonium nitrate makes it impossible to reach breakpoint; values are free chlorine residuals

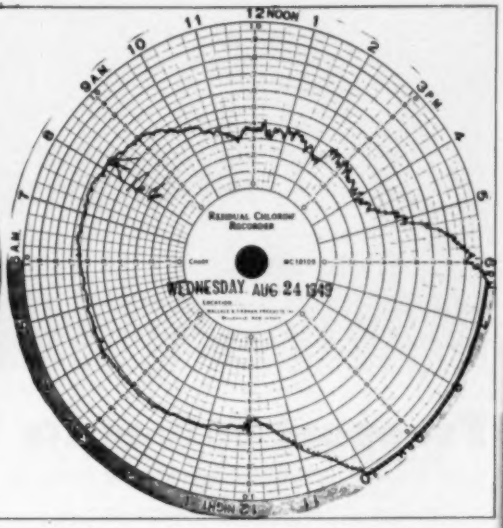


CHART No. 6—Effect of ammonium nitrate spillage on delivered water; values are chloramine residuals

to get past the breakpoint, even though we used our total chlorinator capacity. As an operating procedure we had to shut the filter plant down until this ammonia passed down stream.

In connection with this incident is another record, Chart 6. This recorder was calibrated for total chlorine and indicates that, in the effort to obtain breakpoint, very high chloramine residuals were being developed. This high chloramine resulted in a number of very forceful customer complaints. It is entirely probable that this same situation had occurred before, but we had no evidence of it because we did not have a chart record to detect it. In present operations, we can recognize this difficulty from the chart, trace it to the fertilizer plant, shut down the filter plant and avoid the complaints from extreme chloramine residuals.

We recognize that we have some operating difficulties because we have three sources with their varying flows and demands; we also recognize that we have some flexibility from this layout as well as from the 30 mil. gal. covered finished water reservoir which floats on the system. The latter factors compensate to some degree for the troubles which we have from the first named conditions.

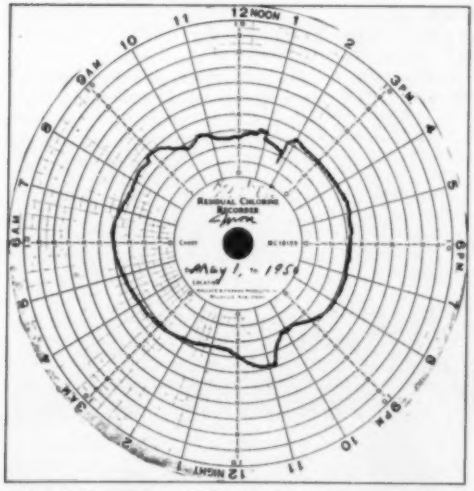


CHART No. 7—Record of residuals in remote part of distribution system

An Interesting Conclusion

Chart 7 provides an interesting conclusion to this story. The Residual Recorder was located in a fire house at a remote point in our distribution system. This record shows that we had obtained a uniform constant chlorine residual at the end of the distribution system. Such a constant residual is the final test of good chlorination operations.

These are days of scientific advances in the operation of water plants. This is also the era of instrumentation in order to avoid as many human errors as possible. It took several years with the aid of the Residual Recorders to investigate the hydraulics and general operations of our treatment plant and to bring the operations under control. As a result we feel that we have been fully repaid by the confidence we now have. The cost of equipment of this sort is insignificant compared to the insurance against the results of faulty operation. We needed a continuous record to show that typhoid fever and dysentery are definitely under continuous control. This instrument provides, not only such a record, but also the means of uncovering any difficulties which might interfere with a satisfactory chlorination operation.

This equipment represents another big step in the parade of improvements, justifies itself over and over again in the study of general plant operations as well as in the control of chlorination for which it was designed. I would not want to run a plant without it.

VENETIAN CANALS of Freeport's Bay Estates Section.

Freeport Solves Its Water Loss Problem

With a resultant sizable reduction in pumping and saving of Water Department dollars.

by GEORGE V. MAURER, *Sup't. of Water, Freeport, L. I.*

FOR the past seven years our Water Department here in Freeport has been wrestling with a main leakage problem. It had reached a critical stage by 1950 and we were becoming desperate, but now we have the solution.

Freeport is an incorporated village on the south, or ocean side, of Long Island. Part of it is directly on East Bay, a sizeable body of water off the Atlantic Ocean.

The population of Freeport is around 26,000 and the per capita water consumption is 80 gpd. or, in round numbers, a daily total of 2,000,000 gals. However, for a good many years our pumpage had been rising farther and farther above this figure until it was well over 3,000,000 gpd. The difference, more than 1,000,000 gpd., was to a major extent due to main leakage.

Most of the leakage was in a section of Freeport known as Bay Estates. This section, originally a tidal marsh, is now an attractive development made up of many narrow land strips separated by canals, which are referred to locally as "creeks"—see pictures. The land strips average 200 ft. wide. Down the center runs a 50 ft. road and the various services including water mains. On either side are building sites 75 ft. deep—see picture.

These water front sites have been very popular with yachting and fishing enthusiasts. Returning from the ocean they can come up the bay, thread their way through the so-called creeks (canals) and moor their boats in the "backyard" as easily as they turn off the road and park their cars in the front yard.

Corrosive Soil the Problem

The mucky soil, made up of meadow bog and salt sand (see pictures), creates a highly corrosive situation in which to lay pipe lines and pitting of the iron pipe used for the original water lines soon started to cause trouble. Fortunately, the problem was recognized as early as 1943 and test sections of other pipe materials were inserted in the mains for observation and study.

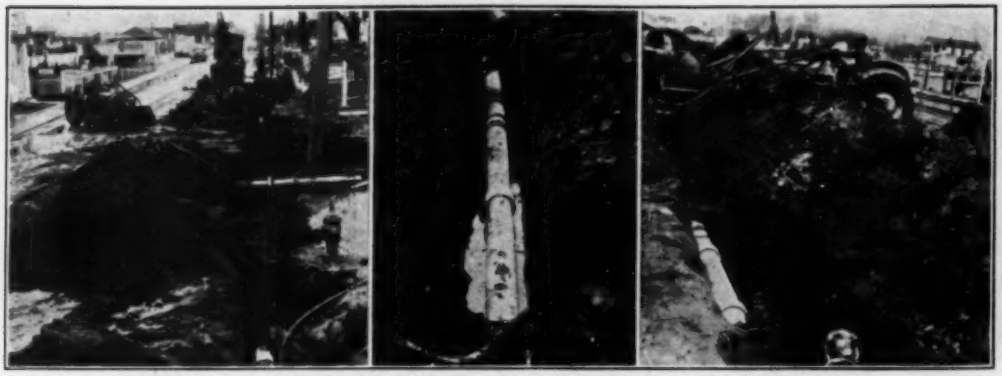
It was the result of our checking of the condition of these test sections that led to our solution. Meanwhile the condition of the existing water lines grew steadily worse. It reached a point where men would locate a leak, shut off, dig up, repair, then turn the water on and realize they had made practically no impression due to other leaks developing on the deteriorating mains.

Even locating the leaks was an exasperating job. The water just seemed to disappear into the surrounding muck. Aside from the always wet condition around the pipe line, which made the task difficult, the streams of water leaking from the line would travel many feet before issuing forth as "fresh water springs."

In one case the water cut its way to a point 67 ft. from the main and at right angles. A sizeable pile of sand had been washed clean and deposited at the point of emission near one of the creeks.

By 1950 repair work could not keep up with new leaks and a replacement

FINGERS of muck-land and "creeks," formerly tidal marsh, hard on water mains.



MARSH MUCK in which "Transite" pipe was used as replacement for pitted and badly leaking pipe.

program *had* to be started without any further delay. Digging up the test sections of pipe installed seven years before, in 1943, it was found that the 200 ft. of Johns-Manville's "Transite" pipe had withstood the corrosive soil attack the best. As a matter of fact, this asbestos-cement pipe showed no indications of corrosion or attack of any nature. The combination of acid soil, salt water and bacterial attack had not affected it in any way. And, from all appearances, none of its original strength or imperviousness had been lost.

Savings Observed

With this evidence at hand the work of replacing old lines with "Transite" pipe was started at once and results were noted immediately. A replacement section of line, comprising 1200 ft. of 8" and 4800 ft. of 6" Class 150 pipe, resulted in a pumpage drop of 1,200,000 gpd. immediately after the section was put in service.

It costs us in Freeport about $22 to pump a million gallons. By eliminating water losses from the perforated mains, we will save around $8,000 in a year's time.

Recently our department has been operating in the red but it is now in the black again, and will stay there as more of the leaky pipe is replaced and our unaccounted for water is reduced. In addition to our savings on pumpage costs we will save the expense f constant repairs.

Indicative of the excellent investment that it was, the "Transite" line that is saving us $8,000 the first year was installed at a cost of only $16,000, so the replacement job will be fully paid for in the first two years.

"Dowsing is Nonsense!"

Tom Riddick's Answer to Kenneth Roberts

"Dowsing is Nonsense," by Thomas M. Riddick in *Harpers Magazine*, July 1951, is an engineer's attempt to lay the dowsing subject to rest, but this time in a more popular type publication which may reach a greater proportion of lay readers. Riddick holds up "Henry Gross and His Dowsing Rod" and its author, Kenneth Roberts, to ridicule through the medium of engineering analysis. Roberts, he says, demonstrates a lack of knowledge of the most elementary principles of water works engineering, and fails to realize that anyone having experience with ground water, with or without a forked stick, could readily duplicate some of Henry Gross' feats of water location. At the same time Henry fails to solve some of the problems which have really troubled water engineers. In order to show the lay reader some of the ridiculous aspects of Robert's story, Riddick goes to some length in explaining ground water hydrology, and compares it with some of the theories of Henry Gross,—in particlar the "dome" theory, according to which each underground "vein" of water originates in a single "spout" of water rising from deep under ground, in one case as deep as 57,500 feet. Water at this depth would be released only as superheated steam, says Riddick. Among the most nonsensical features of his performances, Riddick says, is the degree of accuracy with which many of Henry Gross' prophesies are reported,—with an exactness far beyond what could be obtained from actual measurement. Giving the yield of a well as 42¼ gallons per minute is like measuring the length of a limp bath towel to the hundredth of an inch, says Riddick. Beyond mild ridicule Riddick refrains from attacking the more extreme feats of Henry Gross, such as long distance dowsing and depth finding. In these, he says, Henry owes his abilities largely to Roberts. In reporting bacillus coli to have been "less than 2 in 100 million," as having been found by "chemical analysis" Roberts' terminology is both incorrect and meaningless, says Riddick. Riddick's firmest position as a water works engineer is stated in his reasons for writing on the subject, wherein he says that Roberts' suggestion of shallow dug wells as an ideal source of water supply may do real harm by promoting the use of such sources in some of the many areas where they may be dangerous, and in stating that, furthermore, they cannot be relied on as any help in solving our over-all water problems. Roberts does not indicate, much less prove, says Riddick, that Henry Gross possesses any unusual powers to locate underground waters. To accept Roberts' beliefs is to disregard many natural laws, including even that of gravitation, Riddick says.—*P. S. Wilson.*

Mr. Riddick is a Consulting Engr. and Chemist, New York City.

Ohio State to Initiate Sanitary Engineering Course

To help provide much-needed trained personnel in the field of sanitation, Ohio State University will initiate a new curriculum in Sanitary Engineering starting this autumn such has been recently announced by Dean Charles E. MacQuigg of the College of Engineering.

Developed as an option in civil engineering, the new course will lead to a bachelor's degree, or to the combined bachelor of civil engineering and master of science degrees upon completion of five years of study.

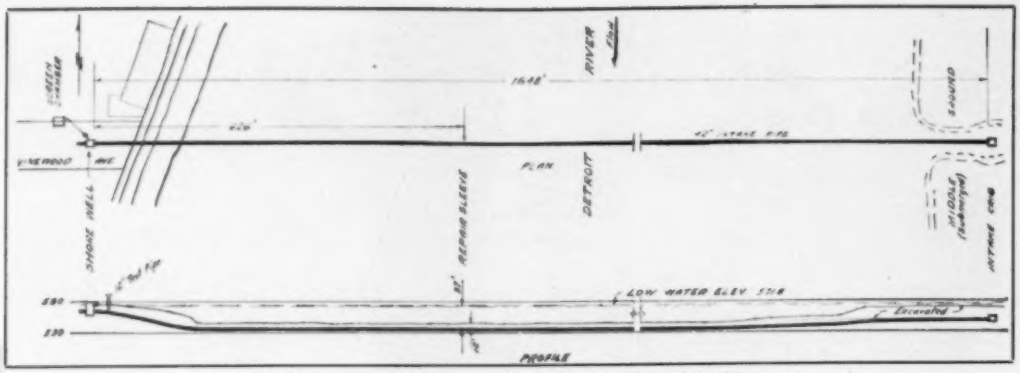


Fig. 1—PROFILE of 42-in. concrete pipe intake at Wyandotte, Mich.

Leak Detection on Sub-aqueous Raw Water Intake Line

Twelve tons of salt and an impedance bridge did the trick.

by GEORGE HAZEY, *Chief Operator, Filtration Plant Wyandotte, Mich.*

A NEW raw water intake line for the City of Wyandotte consists of 1700 feet of 42 inch diameter lock-joint, concrete, sub-aqeous pipe. The pipe was laid in a trench 12 feet in depth below the bottom of the Detroit River. (See Fig. 1.) With the pipe laid, and the intake crib in place, before backfilling, the test showed a leakage of only one gallon per minute. The specifications allowed one gallon per minute per 100 feet of pipe, at a pressure of 15 foot head above river level. Everyone naturally felt quite happy over a good pipe job.

And Then It Leaked

The work left to complete the contract was to backfill the trench and make a final test of the line. A constant head of approximately 20 feet was maintained in the pipe during backfilling operations. The contractor began the backfilling, and about 800 feet of the work had been completed when a leak developed; a leak so serious that two gasoline pumps, delivering about 60,000 gallons of water per hour, were unable to fill the 12 inch riser pipe being used for a test head. Everyone, was of course, disappointed at having a leak develop and the immediate problem was to find the location of the leak. There were many questions: Was it in the covered or uncovered portion of the pipe? Was it a broken pipe or broken joint? Was the trouble more serious?

A meeting was called of all interested parties—the contractor, the designing engineers, and the water department officials. The problem was thoroughly discussed and it was concluded that there were three possible steps for locating the source of trouble:

1. Determine if we had a break in the line.
2. Use immediately available means for determining approximate location of the leak.
3. Devise positive method of finding the exact location of the leak, and check for the availability of the needed materials and equipment locally.

How Not to Find a Leak

The first step was carried out as follows: The pumps on shore had been delivering water to the 12 in. riser pipe, but the water was leaking out through the intake line. We removed the riser pipe that extended above ground level and placed the pump suction hose in the riser pipe so that the hose was below river level. The pump immediately emptied the riser pipe, indicating that water did not flow into the pipe line at the location where the water had been leaking out. So we again placed the riser pipe in place, and began pumping water into it. Again the water level failed to rise in the pipe, indicating that the water was leaking out of the intake line.

It appeared obvious that had the leak or break been in the uncovered portion of the pipe, we should have been able to get water from the river into the intake line through the leak. Failing to do so, it was indicated that the leak or break was in the covered portion of the pipe. Also the fact that the backfill material sealed the leak against river water indicated that the opening was not large.

Now we were ready for the second step. The turbidity of the river water at the time was 30 ppm. The Lake Survey report indicated the river flow to be about 173,000 cu. ft. per sec. Knowing that the leak was in the covered portion of the pipe, under nine to twelve feet of backfill made up of clay and sludge, we looked around for what might be readily used to detect the leak. First, we tried Activated Carbon in a dosage of about 150 ppm. Crews in two boats on the river failed to find any signs of the carbon, which was pumped into the line through the riser pipe. Then we tried Flourescine dye in a dosage of about 2 ppm., but to no avail.

We then applied chlorine in a dos-

age of 25 ppm. to the water being pumped into the riser pipe. The boat crews had a small pump on board the boats. The pump suction traveled along the pipe line trench and one man sampled the discharge constantly, checking it with Orthotolidine for the presence of chlorine. We found several spots that gave the characteristic residual color and we thought that we had found the leak. Bringing water samples to shore, we again checked for the chlorine residual, using both Orthotolidine and Starch-Iodine methods. Both indicated the presence of chlorine, but we double checked the results using a Wallace & Tiernan Amperometric Titrator. The titrator did not indicate any chlorine present in the samples. Further checks of the river water above the pipe line trench on the upstream side shows that the river water contained other substances that gave false results with both Orthotolidine and Starch Iodide.

The contractor then tried using Ping Pong balls filled with Carbon Tetrachloride and Oranges, as a visible means of detection. They failed to work. While the use of these materials evoked humorous comments for some time, we should say that less than 10 per cent of the original amount used was recovered when the line and shore well were cleaned several days later.

It was then suggested that air be used. This was ruled out. Due to the fact that not knowing in which portion of the pipe diameter the leak occurred and also that the pipe contour on the river bottom did not lend itself to the project, the use of air would be dangerous because the entire line would have to be dewatered up to the point of leakage. This would be above the flotation point of the pipe and thus would become a hazardous undertaking. It was suggested that the pipe be diamond drilled at the point just beyond the last backfill portion, and an air line attached. This was ruled out on account of the fact that the air would travel along the top of the pipe to the open end on shore and thus would not indicate any leak on the lower portions of the pipe.

How to Find a Leak

The step, which proved to be positive, was the use of a brine solution, plus instrumentation as a means of detecting the brine in the river water, at the point of leakage. We contacted officials of the local plant of the Pennsylvania Salt Manufacturing Co., and told them of our problem. G. A. Nelson, Plant Manager, advised that they would be glad to be of any assistance to us. He advised that salt was available in any quantity that we might need for the work. As for the instrumentation, he referred us to Russell Cushing, Director of their instrumentation division, for the assistance as to what type of equipment could be used for the brine detection in the river water.

Figure 2 shows the instrument (available locally) that could be used for the detection of the brine. It is the Type 650-A Impedance Bridge manufactured by the General Radio Co., of Cambridge, Mass. This instrument was used because of its desirable features for this work. It has self contained standards and power supply. Results are read directly from dials having approximately logarithmic scales. More than sufficient accuracy and range were available within the instrument. Direct-reading dials eliminated additional time and trouble with calculations. All of these features made the instrument ideally suited for the brine detection by boat crews.

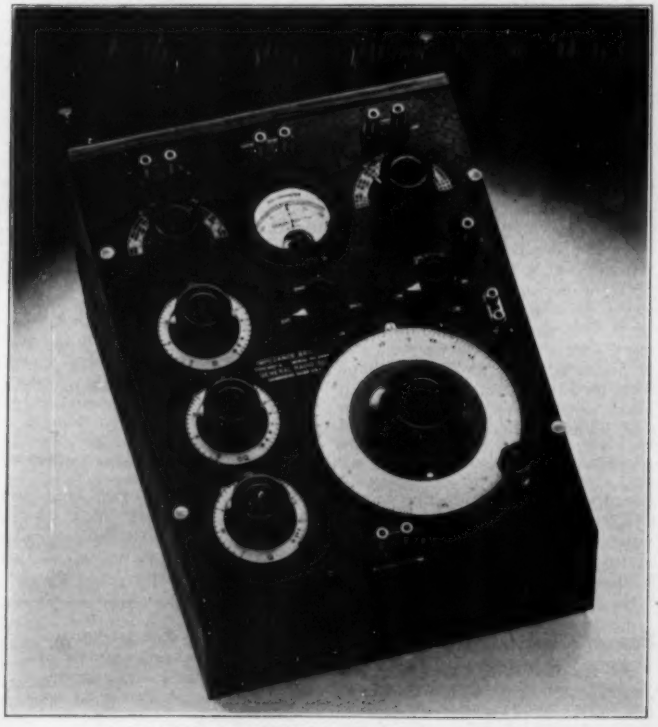


Fig. 2—IMPEDANCE BRIDGE—Type 650-A, General Radio Co.

Fig. 3—CELL USED to detect salt brine in river water.

Figure 3 shows the cell that was made up by Mr. Cushing for use underwater to detect the brine solution. The brass cylinder contains two electrodes of 0.10 inch diameter nickel wire, properly spaced and insulated with plastic. The cylinder was drilled through to allow water to pass by the electrodes. The bottom of the cylinder was solid, and an eye attached for adding the necessary weight to keep the cell on the river bottom. The electrodes were connected inside the cylinder, to 50 feet of regular rubber covered extension wire, and the joint sealed to make it waterproof. The cell was then connected to the Impedance bridge being handled in the boat.

In order to have the electrodes properly spaced so that they would measure the resistance within the range expected to be found in the river at the point where the brine would leak out of the intake line, the cell was checked in the laboratory with known strengths of salt solution. The data shown in Table 1 were taken from a graph of the results.

Table 1

CELL RESISTANCE

PPM. Salt added to Tap water	Cell resistance in OHMS
0	2500
50	1500
100	1300
150	1200
200	1100
250	950
300	890
350	780
400	640
450	620
500	600

A check was made of the resistance in the river water over the intake line before any brine solution was added. These results are shown in Table 2. The principle of the test operation was based on the fact that the brine solution mixing with the river water would increase the conductivity at the point of the leak and the resistance measured would be lower than that of the normal river water. The Impedance bridge would measure any change in the resistance of the river water and thus indicate the point where the brine solution leaked out of the pipe line.

Table 2

RIVER WATER RESISTANCE

Feet from shore	Resistance in OHMS
25	1000
50	2200
100	2500
200	3200
300	3200
500	3000
800	3400
1500	4500
2000	4500

The Impedance bridge was readily adjusted, by means of a knob, to maintain a zero point on the gauge—the zero point being the normal resistance of the river water. In the operations, when the cell came to a point of decreased resistance, this would be indicated by means of a sharp deflection, on the guage, of its pointer.

It was believed that not less than a 3 per cent brine solution should be used, in order to assure effective concentration at the point of leakage. The brine solution would have to be strong enough so that dilution by the river flow would not reduce it too low for the instrument to measure, and yet high enough to be well above the maximum amount of chlorides normally present in the water. At this point, the normal chlorides were about 30 ppm.

The Leak Is Located

The following procedure was used to make and pump the brine solution into the line. The shore well, being of concrete, was used for the mixing basin. One pump took water from the river and discharged it into the well. The pump discharge line went to the bottom of the well, thus giving a supply of water and its discharge force acting as a mixing and dissolving agent. The suction of a second pump was placed mid-depth of the well, and its discharge was into the riser pipe being used for the test head. (Fig. 1). Three men added the salt at a given rate, so as to keep the solution at 3 per cent or higher. This strength was checked constantly. After sufficient brine solution was added to approximate the pipe line capacity of 120,000 gallons, the boat crew then began to check the river water immediately over the pipe line trench. The leak was found in a very short time. Checking and rechecking located the brine solution at the same spot. This spot was marked by land ranges and floating buoys. A complete check was made of the entire pipe line, but no other leaks were detected. At the point where the leak was found, about 650 ft. off shore, the pipe line was covered with clay and sludge to a depth of nine feet.

The total amount of salt used was 12 tons. The amount of salt solution indicated by the Impedance bridge was calculated to be about 1000 parts per million. Later excavation of the covered pipe at about 650 feet from shore was located the actual point of leakage at exactly the same spot indicated by the brine solution. The leak was found to be the parting of an intermediate joint, about 2 inches in width, at the widest portion on the side of the pipe. This intermediate joint was the point at which two 16 foot pipe lengths were joined together to form a single 32 foot pipe length. A special steel sleeve was made to cover the opening. Rubber gasketing was used for the seal of the steel against the concrete. When the leak was corrected and the back filling completed, a final test of the pipe showed a leak of only 3 gallons per minute for the entire pipe line. This leakage was only 17 per cent of the permissible amount given in the specifications. Although the leak had been found and repaired no satisfactory answer was found for it's cause.

Acknowledgement

We wish to acknowledge the sincere co-operation of the officials and staff of the Pennsylvania Salt Manufacturing Co. of Wyandotte, for their interest and assistance in solving our problems.

Telfair Joins Smith & Gillespie

Smith and Gillespie, Engineers, Jacksonville, Florida, have announced that John S. Telfair, Jr., has joined the staff of this firm of municipal consultants.

Mr. Telfair taught Civil Engineering at the University of Florida in 1943 and 1944, specialized in hydraulics with the U.S. Engineering Department and was Regional Sanitary Engineer with the Florida State Board of Health, conducting extensive research in surveys of public water systems, or artificial recharge of groundwaters and in connection with water and sewage works in general.

Everett Clark Moves Office

Everett L. Clark, Consulting Engineer handling water systems, reports, regulatory matters rates, valuations, financial studies, and civil-hydraulic engineering, has announced the moving of his office from the Cairns Building at 108 W. Sixth St. to 1004 A. G. Bartlett Building, 215 West Seventh St. at Spring, in Los Angeles, California.

The Chicago River, the course of which was reversed to provide dilution water for Chicago's sewage, is said to be the only river in the world that flows *away* from its mouth.

Collections and Complaints

One of a Series of Articles

by A. E. CLARK, *Manager, Nashville Suburban Utility District, Nashville, Tenn.*

THESE two words, Collections and Complaints, seem to go together admirably in a public utility. Neither complements the other, but as long as collections are made they cannot be made without complaints.

Collections are made either monthly, bi-monthly or quarterly. As far as the writer can determine there is not any reason for any of the three generally used periods of collecting water bills, and seems to depend on how each water works started their billing. There is considerable psychology in billing because as a rule it is easier to pay a number of small bills during shorter intervals of time than to pay larger bills over longer intervals. A person will pay a $3.00 water bill each month and not complain, but stretch the billing period over three months and render a bill of $9.00 and the chances are that a complaint will be registered. Some utilities allow a discount if bills are paid within a specified time, while others have a net payment period and after the net payment period a penalty is added.

Theoretically, there is not any reason to allow a discount for the purchase of water and its attendant service. The consumer is getting more for his money than any other commodity or service he may purchase. Carrying the analogy further, there is not any reason for adding a penalty if a bill is not paid within a definite period of time. This also carries the psychological element, in that the majority of consumers or people as a whole will take advantage of a discount or will avoid paying a penalty. All other commodities purchased by a person are either paid for in cash at the time of purchase or charged and a bill is rendered each month. In general, no particular incentive is added to entice the purchaser to pay his bill within a certain period of time with this exception, certain bills will contain a provision that if it is not paid within a certain time, interest charges will be added, etc. Practically all utilities have a provision whereby if the consumers fail to pay their bills within a specified time, service will be discontinued. It would seem that with the above provision there is not any need for either discount-and-net, or net-and-penalty billing.

The whole matter of collecting utility bills is a matter of education. It is agreed that for sometime the treatment would have to be rather drastic and would entail quite a bit of extra work, but in the end it would mean less work in the office. It is also agreed that collecting without discount or with penalty added could be worked out much better and with less trouble and complaint in a new system just starting by advising the consumers that they are being furnished water and service at the lowest possible rate, therefore, no discount is being given. The consumers must be made to understand, however, that the bills must be paid within the specified time or service be discontinued. Exceptions must also be made, but only after due consideration and with a just reason. Why a water consumer considers that he should have a discount for paying a legitimate bill within a specified time is not understandable, nor why he thinks he should have his water bill adjusted if he has had a leaking fixture and allowed it to continue leaking with his knowledge. Even in instances where a hidden leak has occurred between the meter and the house or more properly on the part of the service line owned by the consumer, why should the water utility assume any responsibility for this, because they do just that when an adjustment is allowed the consumer. It seems that in many instances the water utility is prone to take what amounts to an apologetic attitude in discussing complaints with a consumer. The expression "The customer is always right" is well known, but when it comes to answering the majority of their complaints they are not right even one per cent of the time. There does not seem to be any logical reason why a public utility should try in any way to put the blame on themselves unless it belongs there. If it does, admit it, to the consumer and let him know what steps will be taken to correct it. A water utility is a business as much as any merchandising establishment in the community and usually with a larger number of accounts.

One of the stock arguments of the consumer is that when it comes to water it can only be purchased from the water utility, which does not have any competition. The writer often wonders if the complainer ever stops to think how silly that argument is. He is under the impression that he is being gouged for every penny that can be taken from him. The majority of his other purchases and bills are much higher than his water bill and certainly he does not receive as much for his money.

It is interesting to make a study of payments. As an example, the percentage paying over the counter and the percenage remitting by mail. Say that a ten day period is allowed for net payment and following this a penalty is added. The bill will show the gross and net amount of the bill. Those paying over the counter pay the net or gross whichever is due without much argument, while a certain percentage of those remitting by mail will send a check for the net amount three or four days after the net payment period, with the check dated within the net period. The envelope will be post marked three or four days after and the post mark is not due to not having received the material in the Post Office the same day it was mailed. They will argue that the check was sent during the net period but was delayed in the mail or will state that the check was dated before or on the last day of the net payment period assuming that if that is the case then the net payment should be allowed. They have their cancelled check to prove that it was dated before expiration of the net period. When they receive their next water bill showing an arrears due then the real argument starts, but can very easily be closed by presenting proof that the payment was not received during the net period.

Delinquents are sometimes difficult, offering as a reason for not paying any number of excuses, while others will pay immediately when the collector calls. Every water department soon learns the so called "regulars," and why they will continue to forfeit a discount or pay a penalty

is an interesting problem since the majority will pay the collector at once. Many departments charge the consumer for turning the water on after having turned it off for nonpayment, and this is another charge on the bill he must pay in addition to the gross bill. It has been the writer's experience that water utilities are much less stringent in collecting bills than other utilities and even though they are, their percentage of loss is at least as low as other utilities and sometimes lower.

Collections depend a great deal on the personality of the utilities employees, the manner in which they greet a customer, handle his complaint, check his meter readings and consumption, etc. The consumer is given every opportunity to pay his bill before service is discontinued. Some utilities send out intermediate notices stating that the account is in arrears and unless paid within a specified time service will be discontinued. The intermediate notice may be followed by a "Shut Off" notice, setting the date on which service will be discontinued. The above two procedures will usually bring in the majority of delinquent accounts, but there are always some who disregard both notices. In this case there is nothing left to do but shut the water off. Many times this will bring on arguments about not receiving the notices and how could anyone be so mean as to shut off the water. They do pay the bill though and the next billing brings on more of the same, maybe some of the "regulars" and a few new ones added.

Let the water bill show a little increase over the previous month or quarter and immediately the consumer calls the office. The first statement is generally to the effect that the amount of water used could not have been consumed and is all out of reason. The next is a recap of the neighbors' bills and the third is how little water they have used in comparison with their neighbors. They don't do any laundry at home, they don't wash the car, they don't water the lawn and a few have said they took their baths at the club, etc., but still their bill is out of reason and think it should be adjusted.

The clerk answering the complaints must be a fast thinker and very diplomatic. In most instances something has to be done to satisfy the consumer that he used the water. The meter is reread, checked for leaks and in a few cases removed for test. These complainers can be quieted by using a "Meter Master," then showing him just how the water was used, usually greatly to his surprise.

Theoretically unless the utility is at fault why should any adjustment be made for a high water bill even thougt it was due to leakage, either hidden or visible. This is another practice which has been carried down though it was due to leakage, either tion. Unless watched closely, the practice of making adjustments without thorough investigation or some other good reason, can become an expensive item. True, it does save some wear and tear on the nerves and is the easy way out. The Water Department, however, needs all the income due it.

Executive of Western Canada Water and Sewage Conference

The accompanying photograph was made during a recent meeting of the Executive Board of the new Western Canada water and sewage conference held in Saskatoon, Sask.

From left to right around the table are Director F. E. Balshaw, Calgary, Alta.); Vice-Pres. N. S. Bubbis (Winnipeg, Man.); Director D. G. Hoskin, (Saskatoon, Sask.); President C. S. Forsberg (Univ. Saskatchewan, Saskatoon); Director Warren Stewart (Rep. from Western Canada Equipment and Contractors Assn., Saskatoon); Secy.-Treas. H. C. Lindsten (W. & T. Ltd., Winnipeg); Director W. G. McKay (Consulting Eng., Flin Flan, Man.).

President Berry Honored by Canadian Section

The Canadian Section of the Am. Water Works Assn. most fittingly honored Dr. A. E. Berry during its recent annual meeting in Winnipeg.

The occasion for the especial recognition was Dr. Berry's 20 years of service as secretary of the Canadian Section and in commemoration of his election to the presidency of the parent association. Dr. Berry, however, will continue to serve as secretary—extraordinary of the Canadian Section much to the pleasure of the Canadians and all who know of his splendid service to the Section these two score years.

In honoring Dr. Berry the Canadian Section presented him with an artistic scroll and a tea service of sterling silver in magnificent Old English pattern. At the center of the silver tray is engraved the following—

"Presented by the Canadian Section of the American Water Works Association to Albert Edward Berry, M.A.Sc., C.E., Ph.D., M.E.I.C., at its Annual Convention in Winnipeg, Manitoba, May 22, 1951, on the occasion of his being elected President of the American Water Works Association and on the completion of twenty years of service as Secretary of the Canadian Section."

In accepting, Dr. Berry characteristically responded—

"Nothing is finer in life than to have good friends, and I have been abundantly convinced over the years that there is no place where this opportunity for true friendship flourishes better than in this Section. This is an unparalleled example of your kindness, and such gracious consideration can but give me renewed incentive to serve you to the utmost in the future."

Diversion and Regulation of Public Utility Funds*

by R. E. McDONNELL, *Burns & McDonnell Engineering Co., Kansas City, Missouri.*

CITIES have gradually increased the number and extent of governmental services provided to citizens. The public thus has become educated and accustomed to the enjoyment of services which, though at first regarded as luxuries, are now necessities and are definitely a part of good government. Certain standards of governmental services are expected, and to be denied the accepted standard immediately brings protests and complaints.

The cost of providing these increased services and maintaining accustomed standards is far beyond the available funds that many cities are prepared to pay from traditional sources of revenue, such as taxes and special fees. Because of this circumstance, cities have searched for additional means by which to finance their operations. The purpose of this paper is to consider one of the methods currently used, by cities which own an electric system, to meet the need for increased revenue, namely: diversion of money from the receipts of the municipally-owned electric utility system to the operation of the city government, either in the form of free services, taxes, or contributions to the operating funds of the city.

Whether the utility is municipally-owned or privately-owned, the city officials have searched every possible source of revenue. If the utility is privately-owned, the levying of taxes against it has proved most remunerative as a source of municipal revenue. The excess profits tax of many privately-owned utilities has reached enormous sums, and the citizens naturally feel that this belongs to the consumers of electricity and should be returnable either in the form of reduced rates or taxes. It has been shown that in those cities in which the utility is municipally-owned the governing body has, in many instances, taken large sums from the revenue of the utility for conversion to the operating funds of the city government.

Ed. Note: This article by Mr. McDonnell was presented a few months before his retirement from the firm on April 2nd, just 53 years after its founding. The ceremonies attending his retirement were reported in the May issue of *Water & Sewage Works.*

Although this article was written expressly about municipally owned electric utilities, it contains much wisdom and comment that is equally applicable to municipally owned water utilities. We are happy to publish this condensed version which deals with the general phases of the topic.

Unsoundness of Practice

The practice of using a municipal system as a tax collecting agency is neither sound nor equitable. Most managers of such utilities consider such a policy neither safe nor sound. Many municipal systems, do, however, contribute to the general fund of the city an amount equivalent to the taxes formerly paid by the privately-owned utility in the community, or an amount equal to that which the city would receive in taxes if the utility were privately owned. In many cases these contributions by the municipally-owned utility exceed the tax payments that would be imposed on a privately-owned system in the community.

There is no justification nor sound procedure in operating a city out of the revenue of the municipally-owned utility. It is also doubtful if there is any legal basis or right to appropriate to the operating funds of the city any amount from the gross revenue of municipally-owned utilities in most instances.

A few cities have legalized the appropriation of money from the receipts of a city-owned utility by passing ordinances, but most of such appropriations are not legalized through any state law. The amount appropriated appears to be determined by the need and greed of the governing body of the city. The greater the amount appropriated, the less the funds available for maintenance, extensions, and improvements to the municipal utility. Jacksonville, Fla., for example, appropriated nearly one-half of its gross electric utility revenue to the operating expenses of the city, and yet the utility itself was sorely in need of improvements, and the units were so overloaded that the city was forced to call on outside agencies to furnish power to carry the system over the peak loads.

Uniformity of practice and the legalizing of a reasonable sum that may be diverted to the city from the receipts of a municipally-owned system is desirable. Such legislation is being proposed by the Kansas Assn. of Municipal Utilities in a bill that would limit the amounts appropriated to not more than 20 per cent of gross revenue.

The residents of a city have the right to expect that the city-owned utility will not be an added burden of expense to them. Municipally-owned utilities should, therefore, be self-supporting. The term "self-supporting" is interpreted to mean that the utility should adopt a rate schedule high enough to yield sufficient revenue to pay current operating costs of the system, retire the bonds issued for the purchase or construction thereof, provide funds for replacements and extensions to the system, and pay into the operating funds of the city each year an amount equal to that which the city would receive in taxes if the property were privately owned. To expect more than this is unreasonable. The desirable policy is to use any profits above these items as a basis for reduction of rates, thereby giving the consumers the benefits of the savings derived from municipal ownership.

Cities throughout the country especially California cities have provided special charter privileges controlling contributions to the general fund. Kansas City, Kan., secured legislation limiting its contributions to an amount not exceeding 3 per

*A condensation of a paper presented before the California Municipal Utilities Association.

cent of its gross revenues and further providing that no contributions could be made while any revenue bonds were outstanding and unpaid.

Many cities over the United States, especially California cities, have operated from appropriations from a general fund and paying all its revenues into the same fund. Palo Alto still continues this policy. The Los Angeles City Charter provides that the water revenue or power revenue shall be appropriated or used by returning and paying into the general fund, any surplus money in either fund. Such payments must be made by consent or approval of the Utility Board. The present policy of the Los Angeles Water and Light Board is to return 5 per cent of the gross revenue of water and 5 per cent of the gross revenue of power to the general fund. This amount now exceeds $3,500,000 annually. There is now no permanent formula or law, stabilizing the amount and to have an excessive amount paid might seriously cripple or endanger any long time program.

The municipally-owned water and power systems of Pasadena, Glendale and Burbank, have also made contributions to the general fund under charter amendments adopted in these cities, each of which have the City Manager form of government, with the utility managers directly responsible to the city manager. This may work well from the point of view of the city manager but it does not afford the utility manager full opportunity to acquaint the public with the need of a long range program of financing and construction. It has been my experience that city managers have a much shorter tenure of office than the utility managers.

Burbank, a city manager governed city, resorted to a bond issue of $2,500,000 to construct an addition to their steam generating plant. The Council agreed to a 5 per cent of gross revenues limit in transfers from a former 15 per cent limit. The total transfers in lieu of taxes transfers amounted to $657,760. The City Manager and City Council are in a position to make any transfers that they see fit.

Glendale in 1946, transferred by vote of the people, $1,950,000 from the public service funds to finance a sewer plant, incinerator, a stadium and parks and playgrounds. The loss of these funds would naturally handicap any city in its capital expenditures for utility plants. No safe or long time plan of expansion can be made with finances so uncertain. Limitations in transfers are desirable.

The American Public, especially the utility users, are slow to want any change in their technically trained management while city managers are frequently changed. In California, several cities have changed or procured new city managers during the last year leaving some utilities with urgently needed programs partially completed. Much confusion existed until new utility boards could be created or new programs brought before the public.

To achieve the best results, consulting engineers of wide utility experience, believe a ten, fifteen, or twenty year program of financing and construction, should be carefully studied and then let the public be acquainted with it. Such a program calls for financing new units at certain intervals all of which would be upset by large diversions of funds for other purposes.

It may be said that these are matters for the public to decide and pass upon and that if the public approves of diverting funds, let it rest there.

I do not want to stir up any controversy between managing boards and their employed managers, all I am suggesting is that careful study be given to a balance and result that will not injure or cripple the growth and expansion of the utility itself.

In my fifty-three years engineering experience, I've seen many plants lost to the cities by milking them dry by diverting revenues to all sorts of projects, when the funds should have gone into new units with their low cost of production. These funds cannot be eliminated or avoided entirely and it is only the *dangerous* diversion that should be guarded against. It is nation wide. Tacoma pays up to about 7½ per cent of its gross revenue to the city. Seattle and Tacoma have an occupation tax and pay a business activities tax, gas and auto tax, sales tax and hydro license fees.

One of the dangerous diversions is at Ashland, Ore., where 40 per cent of the city's budget comes from the light fund. In Cashmere, Wash., the city light department built and owns the city hall. In Idaho Falls, the light department owns swimming pools, a golf course and the city hall but is now considering a bond issued to rebuild its antiquated Power Plant. This is truly a dangerous diversion.

The argument goes back to "What is the real meaning and objective of Public Ownership?" My definition given in a debate on the merits of Public verus Private, fifteen years ago still holds good. It was as follows:

"The real purpose and objective of public ownership is the ownership, operation and management of electric utilities in a manner so that the greatest good and benefit will accrue to the public as their owner. In one case the public is the beneficiary. In the other the private owner, capitalist or holding company is the chief beneficiary. It would seem that an ownership which gives all its benefits to the public is preferable to an ownership which gives its chief benefits to an individual. In one the profits go to the public in the form of lower and lower rates. The basic purpose of private ownership is private profit, which goes to swell the already fat incomes of utility magnates and holding company officials.

"Electricity, the article produced, is the same regardless of ownership. It is a standard product, producing the same results when used. There is little or no difference between the generation costs under municipal or private ownership. A pound of coal, a barrel of oil, or falling water produces just as many kilowatts for the public as it does for an individual. The real merits of arguments, therefore, relative to public ownership relate largely to that of management, control and operation."

Chartered Diversions

Many cities have no choice in the matter of diversion of Utility Funds to the general fund. This is provided for in the City Charters. For example in Palo Alto, the Charter specifically and in a very fine manner, provides that the revenues of each public utility shall be kept in a separate fund from all other receipts and shall be used for the purposes and in the order as follows:

a. For the payment of the operating and maintenance expenses of such utility, including the necessary contribution to retirement of its employees.
b. For the payment of interest on the bonded debt incurred for the construction or acquisition of such utility.
c. For the payment of the principal of said debt as it may become due.
d. For the capital expenditures of such utility.
e. For the annual payment into a reserve fund for contingencies, of an amount not to exceed ten per cent of the expenditure for capi-

tal outlay for the year, exclusive of the bond fund expenditures. The total accumulated in this reserve fund for contingencies shall at no time exceed over 5 per cent of the book value of the utility's capital in service. This reserve fund shall be available for use by the utility, only for the replacements or emergency repairs and after special appropriation by the council.

f. The remainder shall be paid into the general fund by quarter allotments.

This is the manner in which the utilities are managed and operated in Palo Alto and from a personal knowledge of the results I would say that it works out to the satisfaction of the public. The proof of the pudding is in the eating. The rates are reasonable. The City receives a substantial surplus to its general fund each year and is in a large part responsible for the low tax rate. The City has good credit selling its street improvement bonds for 2¾ per cent interest rate and its general fund bonds for 1¼ per cent interest rate.

Types of Management

There are now existing about 3500 publicly owned electric systems in our country and almost as many different kinds of ways to manage and operate them. (Public water utilities likewise have many ways of management and operation.) This is not to our credit. It does seem as though we would, after years of operation, have discovered some one best plan of management and control or operation that could be used as a model. We engineers believe we can design a perfect plant in all its details of generation and transmission of power, but when it comes to a governing body to place the product, electricity, on market, that is a different story. Our engineering schools cover all phases of design and materials in getting perfect and efficient operating units but the cities or districts are left to struggle with the problem of management by council committees, boards of trustees, or utility boards. Then comes up the selection of these boards, how and by whom named, tenure of office, compensation, how and when replaced.

The smaller cities pretty generally adhere to councilmanic management where the city councilmen and mayor name the superintendent. Then to avoid frequent changes, boards of public works or boards of trustees were advanced as an improvement. Cities with a desire to improve on mayor and council form of government changed to a commission type, with one of the commissioners being given the title of public utilities commissioner. This centralized the utilities in the hands of one man, which was an improvement but its chief difficulty lies in the fact that the other city commissioners frequently make impossible demands for a share of the revenues to maintain other city departments. Springfield, Ill., is a good example of this type of management. The utilities, both water and lighting, have been built up to become models but due in a large measure to having elected utility commissioners who defended the use of revenues first for maintaining the utilities in first class condition. Cities of this type of management are common but they are always besieged by demands upon the funds which, if granted, would milk the plant dry and prevent extensions, expansion growth and modernization. By giving way to these demands, many cities are turning to revenue bonds to finance major improvements where formerly revenues were used.

The trend toward the council-manager form of government is bringing about many changes in the management of municipal utilities. We now have about one thousand cities that have adopted this new form of government, and its advocates strongly contend that it is the best form of government known for municipalities.

It may be the best form of government so far adopted for municipalities but in many of the cities that have changed, no adequate provision has been made for taking over and handling the utilities. It is just assumed that a city manager will in some way take the place of a board of utilities or a board of public works, or somebody that has been handling, efficiently and satisfactorily, the utilities. Any number of cities have experienced a very confusing situation in this respect in the last few years.

Changes of exactly this character and nature are now taking place in city after city throughout our country. It merely emphasizes and shows the need of more thought and study being given to utility management in some permanent, satisfactory way. It is a case where research of some kind could well be made to determine the best type and form of management.

Trends

It takes more than a mere economic analysis and study to show whether a plant can be operated profitably and paid for out of the revenues. The problem now involves research and a study as to what type of management is going to be given to the utility if it is publicly owned. Many managers of municipal utilities may sit complacently thinking their type of management is so perfect that it could not be upset.

The wisdom and foresight of municipalities to create board of commissioners or boards of utilities for the handling of water and lighting plants is well established. The trend is in this direction now. The greatest progress in the handling of municipal utilities is the placing of utilities in the hands of a high class board of directors, who in turn employ a manager, who then employs skilled engineers, operators, superintendents and employees on a purely business and ability basis. A board management gives continuity of handling, enables the making of a comprehensive 10, 15 or 20 year program of improvements, avoids the constant changing of managers and insures competent employees permanent positions.

There is nothing quite so distasteful to a technically trained engineer or operator than to engage in politics. We would like to see the managers of water and lighting plants, who are technically trained and experienced, keep their positions. Good service to the community depends upon their keeping their positions and yet their positions are jeopardized at every election time. This will continue until we, ourselves, remedy the situation by placing the utilities in the hands of non-political boards which are interested in good management.

We are slow to adopt any reforms or improvements until we get into trouble and then it is often too late. Nowadays we have much more to concern us than merely the creation and distribution of kilowatts. We have the Tennessee Valley Authority, Missouri Valley Authority, the Central Valley Authorities, and the creation of power districts, the building of transmission lines and marketing power. All of these will be hot issues for the next few years. It behooves us to be thinking of what improvements we can make in our own type of management of utilities. We are prone to criticize anything new.

Public vs. Private Operation

The real purpose of public ownership is the operation and management of the utility in such manner as to get the greatest good and benefit

to the users, the owners. The basic purpose of private ownership is private profit, for it must be remembered that no private company plans to operate a utility without returning to the owners and stockholders a profit from the operation. We, therefore, must look quite definitely at management, comparing municipal operation and private operation. Both should aspire to good management. Each should strive to supply service of a good quality meeting all requirements, and do this at a reasonable cost. Neither side has a monopoly of brains or ideas required.

If any deficiencies or shortcomings in the management and operation of a publicly owned plant occur, every citizen, who is part owner of the property, readily voices his disapproval and objection. So the loudest outcry concerning poor management and efficiency is against the municipal plant. Stockholders of the private plants are usually silent in criticism of operation of the private plant. It is not an uncommon thing for a private plant to extol its virtues, good management, and operation, through paid advertisements in the press. It is a very uncommon thing for a municipal plant to give display advertising to its municipal management and operation.

Municipal Utilities Should Recognize Their Faults

The chief argument used by the representatives of the power companies in promoting the purchase of municipal utilities is: "The frequent changes of management occurring in municipal utilities." This is, undoubtedly, the most difficult argument to answer, for it must be conceded that the frequent changes of operators, engineers and superintendents is a distinct disadvantage in municipal ownership; but, it is one that could be corrected; and can only be corrected by the municipalities themselves.

To illustrate the evils of this political management we have but to cite the conditions in Indiana in the last year, where 65 municipalities changed from Republican to Democratic control, and in nearly every instance where these changes occurred there was a change of water and lighting superintendents in the municipal plants, often displacing a thoroughly trained and experienced man.

Council management of water and lighting utilities, with the change every administration, is a weakness that should be recognized and corrected by the superintendents themselves, if possible, and a concerted effort should be brought to bring about state legislation creating Utility Board management. The need of utility board management comes about when a needed bond issue is required, and very often the defeat of a bond issue is attributed to the fact that there is a growing feeling on the part of many leading citizens that a board of utilities should be free from politics, serve the city without pay, and be composed of leading business and professional men of the city, who would be pleased to serve on such a board for the honor of serving their community.

Maintaining Highest Efficiency

The best weapon a municipal plant can use to defend itself and preserve its stability and maintain the confidence of the community, is to keep the plant at its highest efficiency. To permit a plant to become antiquated or obsolete weakens it against any attacks. Like an individual whose vitality is low, the plant is in no condition to put up a strong defense.

How to Save the Utilities

The "saving" of municipal utilities can only be brought about by those who are in charge of operation and management; and some of the measures that have been most effective in accomplishing this result are, as follows:

1. Educating the public to the advantages of municipal utilities through publicity, frequent press articles and talks before civic organizations on the achievements of municipal utilities.

2. Interesting the best businessmen and leaders of the community, soliciting their aid and effort in bringing about Board management; and getting the leaders of all political parties to agree on Board management; prepare and support ordinances and laws making Board management possible.

3. Municipal officials, especially superintendents and managers, are too often content to devote their entire time to the management of the plant, and to neglect other civic activities, and to neglect to take part in legislative acts that would improve their conditions, and to retire from accepting civic responsibilities.

4. Keeping the public thoroughly informed on the needs of the utilities by frequent reference to the growth and expansion of the plant, showing wherein the municipal plant needs revenues or bond issues in the same way that a privately-owned plant secures expansion through stock issues; and thus avoid spasmodic efforts in educational bond campaigns.

5. Invite civic organizations of all kinds to visit and inspect the municipal utilities.

6. Salaries commensurate with the work and responsibility of technically trained men cannot be paid by political boards, for fear of criticism; but, a utility board free from politics, can pay salaries commensurate with responsibility and ability, with the result that many superintendents are now drawing better salaries under board management.

7. A long time, comprehensive program of five, ten, fifteen or twenty years, should be prepared by consulting engineers in behalf of every municipal plant; and then by working to this program the best results can be obtained. A program of this kind avoids a haphazard policy.

8. Impress upon the cities the importance of the utilities, for they are usually the city's largest industrial enterprises, and the municipal utilities (both water and light) affect every man, woman, and child in the municipality. Their growth means a wider growth and prosperity for the entire city.

Type of Board Recommended

Utility boards generally include three to five members, and their terms of office are generally so rotated that not more than one member is relieved of his duties at any one time. This is accomplished by varying the term of office for the first members of the board. Often the personnel of the boards is left unchanged by continued reappointment of those members who have demonstrated their willingness and ability to manage the affairs of the utility property. The continuity naturally contributes to a greater uniformity of policy, and permits well-thought-out, long-range improvement planning.

The utility board has additional advantages when applied to the management of two or more utilities. If the fullest measure of economy is to be realized, these two or more utilities must operate as nearly as practicable as a unit, in some department at least. They will want a common agency for supply purchases and a combined meter reading and billing department, and such provisions are possible with utility board management.

Rates

In many cases, rate schedules have been adopted without proper and adequate study. Local managers, superintendents, and operators dread to tackle any revision of rates, feeling that such a step is loaded with the dynamite of criticism. The author was once called to the Pacific Coast to make a study and investigation of rates. It was explained that only a disinterested, outside engineer could withstand the criticism that would follow any rate revision.

The rate structure of utilities are the most dangerous things to tamper with, and yet they are the one point of management and operation wherein there is the greatest need of improvement, standardization, and equalization. Rates should be in keeping with the operating expenses and fixed charges necessary to maintain the value of the property. With the varying and fluctuation in prices of fuel and labor, no industry can survive unless the rates reflect these changes. Fuel or power is the largest item in operating costs and if this doubles or triples in cost, it becomes necessary to revise rate schedules. It is always easier to revise downward than upward, yet with a plain statement of facts it has been surprising how little opposition was voiced at rate raises during the last two years of upward raises in rates. Here a consulting engineer can often relieve the superintendent or manager of criticism by working out a revision of rates.

Taxes

Practically every publicly owned plant in the country has a policy of paying into the City Treasury an amount equal to, if not larger than that which would have been received had the plant remained under private ownership. The amounts paid into the treasury in the form of free service and contributions is about two to three times that lost in taxes.

There is no justification whatever in managing a plant and giving free service to a community without at least charging back the cost of the service rendered. It should be on a business basis wherein charges are made for all service furnished and delivered. If a surplus accumulates, rates should be reduced. There is no excuse for trying to run or finance a city out of the revenues of the city's utilities. A few cities have boasted of the fact that they are tax free, citing instances where the revenue from the publicly owned utilities is sufficient to run the city. This, in the opinion of the author, is not a sound procedure or practice and should be weighted against the taxes paid by the privately owned utilities to compare the community benefits locally and nationally.

Who Are Owners

The owners of municipal plants are the citizens themselves. A large part of the cost is hidden and beneath the ground and the conception of the project is gained, whether it be good or bad, by what is observed above ground in visiting the installation. There is nothing that conveys the idea of good service more vividly than a visit to a plant kept spotlessly clean, pleasing in appearance, well maintained and beautified.

To a consulting engineer looking at utility management and operation, there is much encouragement in looking back over what has been accomplished over a long period of years of association with the utility operators and managers. Very great improvement has been made, and progress is observable on every hand in making the management better and better. There are still problems to be solved, however. If this paper appears unduly critical it is only with the hope that such critical analysis will assist in the solving of some of those problems. More than fifty-two years' association with the utility fraternity has convinced the author that only by a searching analysis of past failures can the groundwork be laid for the improvements which will be necessary tomorrow.

"Doc" Symons Establishes Independent Consulting Service

Our Loss; His Gain

It is with considerable regret that we announce that George E. (Doc) Symons, Managing Editor of *Water & Sewage Works* is resigning his position effective Sept. 15th in order to establish an independent consulting service. We are happy to report, however, that we are not completely losing the valued services of Dr. Symons, who will serve as Contributing Editor and Columnist.

In his new endeavors, in addition to offering technical consultation on plant and laboratory design, research, and operation problems in the field of water, sewage, and industrial waste treatment, Dr. Symons will also do free lance writing and editing of technical articles, bulletins, house organs, specifications, and engineering reports. He will continue to serve as consultant to B-I-F Industries of Providence, R.I., and as Editor of *The Courier* for Builders-Providence, Inc., Omega Machine Co., and Proportioneers, Inc.

A graduate of the University of Illinois, Dr. Symons has a wide background of experience as a teacher, researcher, operator, lecturer, columnist, editor, and consultant. Author of more than a hundred published articles and reports, and a licensed Professional Engineer in New York State, Dr. Symons was Editor of the 9th Edition of "Standard Methods for the Examination of Water & Sewage," editorial co-ordinator of the 2nd Edition of the AWWA "Manual of Water Quality and Treatment," and Co-compiler of the 20 Year Index of Sewage Works Journal."

Formerly Chief Chemist of the Buffalo Sewer Authority and still consultant to the Authority, Dr. Symons was co-author of the "Buffalo Formula" for charging for industrial waste treatment and author of a plan for industrial waste pollution abatement of the Buffalo River.

Dr. Symons' biography is listed in the Monthly Supplement to "Who's Who In America," and in "Who's Who in Engineering" and other biographical reference works. He is a member of Sigma Xi and other honorary and professional fraternities, and also a member of the Am. Chem. Soc., Am. Inst. Chem. Engs., Am. Pub. H'lth Assn. (Fellow), Am. Soc. Civ. Engrs., Am. Wat. Wks. Assn., N.Y. St. Soc. Prof. Engrs., and the N.Y. Sew. & Ind. Wastes Assn. of which he is a past-president. The N.Y. association voted him the Kenneth Allen Award for Research of noteworthy nature.

For the immediate future, Dr. Symons' office will be located at 86 Edgewood Ave., Larchmont, N.Y., a suburb of New York City.

Harrison Hale To Southern State College

Harrison Hale, Emeritus Professor at the University of Arkansas where he was head of the Department of Chemistry and Chemical Engineering since 1918, has accepted the position of Head of the Department of Chemistry at Southern State College, Magnolia, Ark.

Prof. Hale is best known in the field of water and sewage works for his long time secretaryship of the Arkansas Water & Sewage Assn.

Industrial Wastes

"A Worm's Eye Viewpoint"

By
L. L. HEDGEPETH

The basis of this paper was a discussion before the New Jersey Sewage and Industrial Wastes Association presented as personal remarks by the author, former Executive Director of the Virginia State Water Control Board, who is presently Staff Consultant to the Calco Chemical Division of the American Cyanamid Co.

The author has recently completed a three-year term on the Board of Control of the Federation of Sewage and Industrial Wastes Associations.

THE waste disposal program of the writer's Company is moving along satisfactorily. New and old ground is being plowed in an effort to find suitable answers to specific problems. It is time consuming and often frustrating, but there is enough success to be encouraging. None of it is yet ready for release and the context of this article does not deal with scientific fact, but presents certain philosophical views on the industrial waste phase of the stream pollution problem in general. The views expressed are personal and are shared by some but not all of chemical industry's waste disposal men. Neither have they been approved nor disapproved by my principals.

The title of this discussion was selected as descriptive of the realism required to visualize the elements of this picture. When one spends his working hours for years looking up industry's tail pipes, the glamour and the polish disappear and one is left with no illusions about the ugliness and the magnitude of the industrial waste problem. Although some progress has been made, it is the dominant factor in today's stream pollution picture. In some cases, the situation may be made tolerable by improved public relations. In many cases, the discharges are so massive and so debilitating on the downstream waters that there is no cure and good public relations can accomplish little, however skillfully applied, in removing the stench of gross pollution.

The major factor causing this is poor location of the plants with respect to assimilation resources of the stream. Too often, the layman assumes that pollution correction is merely a matter of waste disposal investment, and that treatment may be provided to fit any case. Waste treatment men know that complete elimination of pollutants is not accomplished by the treatment of water-borne wastes and that a residual of pollutants is always present in treated effluents. Further, that the only means of totally eliminating industrial pollutants is to convert the plant to anhydrous processes, or to close down the plant.

The adoption of cyclic and anhydrous methods of making chemicals will do much to alleviate pollution, but most of the processes employed by the chemical industry today are water developed and there is required for each such plant an expendible assimilation balance in the receiving stream. If this is not provided, stream degradation will be the certain result. There, in a few words, is the crux of the problem. Research, tightening up waste prevention, and providing more treatment may help some, but they will not solve the problem imposed by an elephant of a plant on a small stream, or on a large stream of low assimilation resources.

Where Does the Responsibility Rest?

The responsibility for this situation rests not only on industry, which must operate its plants, and on the public which wants industrial payrolls without looking into the price to be paid for a polluting plant, but on the professional workers in this field. I am beginning to believe that it is we who are largely responsible and that we need a moral reawakening. This was called to my attention last fall by one of our chief chemists. He said, "Hedgepeth, you stream pollution people as a class are given to pious utterances. You condemn stream pollution on one hand and condone it on the other. You'll get more done if you stick to your conviction."

The more I think about it, the more I think that he's right. Being constantly confronted with the necessity of balancing the economic health of a community against the aquatic health of a stream, we are inclined to try to carry water on both shoulders. As a result, plants or expansions are mislocated and stream degradation sets in. For, as Velz points out, nature is a stern banker and will not tolerate defaults in the payment of the stream pollution debt. It must be met, and on time, or the stream will become bankrupt.

Too often, study and conscientious work on the problem merely reaffirm what we as a group already know—that there is no adequate treatment as such for many of the industrial wastes, and the only practicable disposal method is by dilution. Then the awful reality becomes known—there is no treatment, and the dilution is not enough, and the only way to restore the stream is to close the plant. Thus a conflict develops between the weekly payroll and the health of the stream. The stream cannot win that argument for, as Mr. Justice Buchanan of the Virginia Supreme Court of Appeals observed, "The aesthetic and recreational features involved in the pollution problem are important, but the opportunity to make a living may be even more so."

So the stream remains polluted and is studied, and studied, and studied, ad nauseam. It is put under orders which cannot be met, thus impairing the dignity of the Law and earning us the title of pious Willies. This is a common situation in the industrial states—few of the other states are free of it.

The blame for this largely rests on the stream pollution scientists. Industrial management cannot be expected to be familiar with the mixture of experience, judgment and scientific factors which make up the stream pollution control picture. Their job is to plan wisely for the economical production of salable goods. The community planning people cannot be expected to know. Their job is to get new payrolls into the community. The only really well

"... one is left with no illusions about the ugliness, or the magnitude of, the industrial waste problem."

". . . the rearming of our country is vital, but the protection of our natural waters should not be sacrificed."

informed parties involved are the professional stream pollution workers. We know—or we should know if we keep abreast of our jobs—and we alone have the know-how to prevent stream pollution.

Conservation Transcends the Mathematics of Economics

My feeling is that the necessity for the conservation of natural resources transcends the mathematics of economics. In stream pollution control we are dealing with the wise use of a renewable resource, as opposed to its abuse. It is our duty to *prevent* stream pollution. Everyone has an obligation to preserve and improve the soil and water of the earth from which he came. In drafting the Virginia Bill of Rights, the first set of rules by which free men in our country proposed to be governed, George Mason wrote: "The laws of Nature are the laws of God, whose authority is superseded by no power on earth."

The compulsions of any given situation do not excuse anyone from the obligation to protect our natural resources, particularly those of us who have special knowledge in this field. Nor does the assumption of jurisdiction over stream pollution by the Government excuse us. Neither the State nor the Federal Government is able to remove stream pollution by fiat or regulation. They can only institute a measure of control. Inevitably, in the issuance of a regulation, or special order, a compromise is reached between wise use and abuse. And, even if the requirement is enforced, the stream is not really cleaned up. It helps some, but the solution lies elsewhere. That is why we find ourselves constantly running to catch up on stream pollution abatement.

Pollution Control Must Become a Fundamental

Real stream pollution abatement must begin much closer to the roots of the problem. The evils of stream pollution actually begin in the research laboratory, at the conference table, on the first flow sheet, on the drafting board and in the operations control office. They may be corrected only by having stream pollution abatement become a fundamental—a part of the planing all along the line.

Effective stream pollution abatement requires attention by individuals who have become conscious of their moral responsibility to restore and preserve the natural waters of our country. In other words, those of us who have devoted ourselves to this science have a personal responsibility which goes far beyond the slide rule, the oxygen sag curves, the toxicity tables, and the other mechanical means by which we mumbo-jumbo our way through this problem.

At its best, Government can attack only the secondary manifestations of this matter, that is, the actual appearance of pollution. The effective attack must be at the primary causes which, in ultimate analysis, stem from the ignorance, the pride, the greed, and the laziness of individuals, including us. Unless we can get the individual to consider the keeping of the discharge of stream pollutants below the safe assimilation level of the stream as a "must" of life, on a par with schools, churches, community sanitation, and other essentials of a civilized community, we will not get this job done.

There are some who believs that we have passed through the evangelical period of stream restoration and, with the passage of Public Law 845 and the several state water pollution control laws, we are now moving into a period of scientific appraisal to be followed by rigid enforcement. I do not share this belief. From my "worm's eye viewpoint" we slipped backwards during 1950. The rearming of our country is vital, but the protection of our natural waters should not be sacrificed. These are compatible objectives.

We have a considerable educational job remaining to be done—not only to get the seriousness of this problem recognized at all affected levels in industry, but also to constructively deal with the backfire of professional publicity which is beginning to have its effect on our work. Publicity and promotion of sound public relations are necessary adjuncts to any well-balanced stream clean-up program, but they are not in themselves a satisfactory answer.

You cannot talk industrial pollution out of a stream. It may be eliminated by one of, or a combination of, four methods:

1. By proper plant location.
2. By manufacturing process selection to eliminate waste.
3. By manufacturing control to minimize waste.
4. By treatment of the effluents to condition them for safe assimilation in the stream.

To secure our stream clean-up position, our policy, simply stated, should be:

1. To keep presently clean streams clean.
2. To prevent an increase of pollution in polluted streams.
3. To reduce present pollution as know-how is developed.

If these policies are conscientiously observed, we will solve our presently unsolvable stream pollution problems. New plants and new processes can be properly located and engineered to eliminate stream pollution. We are having much success with this approach. Obsolescence of the older and presently polluting processes will ultimately eliminate them in favor of the anhydrous and cyclic processes which characterize the newer chemical engineering developments. The attainment of these objectives will require unwavering devotion to our science. In my opinion, this is a principle on which there can be no compromise.

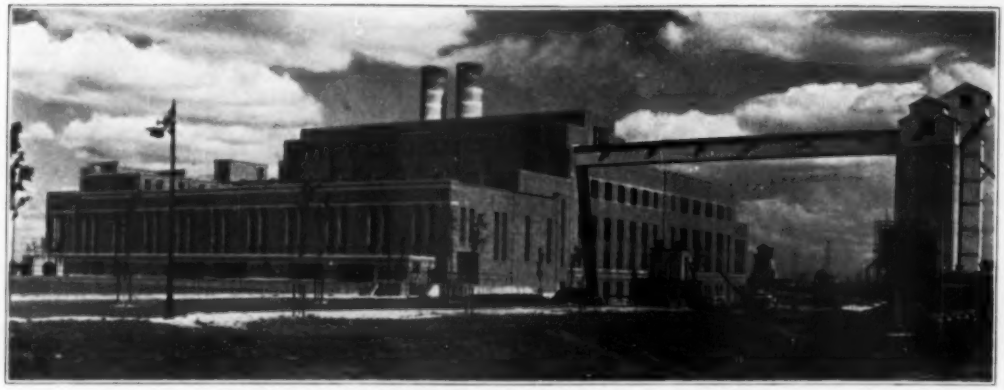
". . . the attainment of these objectives will require unwavering devotion to our science . . . a principle on which there can be no compromise."

B. Everett Beavin Establishes Consulting Office

Everett Beavin, Sr., of Linthicum Heights, Md., announces that henceforth he will be in business for himself practicing professional engineering and specializing in water supply and sewage disposal. His office is located in Linthicum Heights, Md., at 331 E. Maple Rd.

Until recently Mr. Beavin has been associated with Whitman, Requard & Associates of Baltimore. Prior thereto he was associated with the J. E. Griner Co., supervising, design and construction of water supply and sewerage facilities. He served as Project Manager on the design and construction of a Military Air Transport Base for Whitman, Requard and Associates—a $43,000,000 project.

Mr. Beavin is a member of A.S.C.E., A.W.W.A., and other professional societies and is a charter member and a past-president of the Md.-Del. Water & Sewage Works Assn.



CHICAGO, Ill.—Southwest Side Plant—Eight units for activated sludge

Sewage Treatment Plant Equipment

Flash Drying and Incineration

*The Seventh Article of a Series**

by FRANK L. FLOOD, *Partner, Metcalf & Eddy, Boston, Mass.*

THE following article differs from others in this series in that it deals only with the product of one manufacturer although the preceding article covered for the most part only the multiple hearth sludge drying and incinerating equipment as manufactured by Nichols Engineering & Research Corp. As heretofore in these articles it is the intent to record operating experiences and measures taken to improve the equipment and its maintenance so that others facing similar problems may profit thereby.

History

The C-E Raymond system of flash drying and/or incineration was first undertaken on a large scale at the West Side Plant of the Chicago Sanitary District in 1935. Subsequently, numerous installations have been made including other plants at Chicago and at Neenah-Menasha, Wis. (1937); Buffalo, N.Y. (1938); Springfield, Mass. (1940); Cuyahoga Falls, Ohio (1940); Duluth, Minn. (1941); Manitowoc, Wis. (1941); San Diego, Calif. (1943); Battle Creek, Mich. (1944); Sheboygan, Wis. (1946); Houston, Texas (1950); and Los Angeles, Calif. (1950). Large installations not yet under operation include those at Baltimore, Md.; San Francisco, Calif.; Waterbury, Conn.; Schenectady, N.Y.; Bethlehem, Penn.; and Washington, D.C.

In the C-E Raymond system, filter cake is mechanically mixed with a portion of dry material in a mixer of the pugmill type, and then violently agitated in the presence of hot gases in a cage mill. The mixture discharges into a cyclone collector. The sludge at about 10 percent moisture separates in the cyclone from the hot vapors and gases. A portion of the dry material is returned to the process and the remainder may be drawn off and disposed of in the dry form or burned in the furnace which supplies the hot gases for the cage mill.

This type of unit is also used for fertilizer production or for incineration in connection with standard garbage and refuse incinerators. The units at Watervliet, N.Y.; and Stamford, Conn., are of this type.

Buffalo

At Buffalo, N.Y. there are three flash drying units each designed to evaporate 5,833 lb. of moisture per hour with associated furnaces for incineration of the dried sludge. Soon after these units were started in operation, it was found that the sewage sludge contained a substantial proportion of sand which proved to be very abrasive. Points of wear included mixers, the cage mills, the separating cyclones and in the fuel pipeline which transported the dried sludge from the flash drying system to the burners. Operating experiences have been described in the annual reports and by Velzy, Johnson and Symons.†

Drying towers were provided where hot gases from the furnaces are mixed with sludge before passing to the cage mill. These were lined initially with stainless steel plates which became distorted after a period of operation. Replacement of the buckled liners with a ceramic material poured in a wooden form proved to be a satisfactory solution to this problem.

The dry sludge cyclones were originally equipped with mild steel replaceable liners. It developed at Buffalo and elsewhere that this method of lining was uneconomical. The manufacturers made an intensive study of the problem and arrived at the conclusion that a gunite lining, consisting of trap rock and lumnite cement, was a satisfactory and economical protection for the

*Other articles in this series appeared in May, June, August, and October 1950 and in March and May 1951.

†Sewage Works Journal, September 1940.

interior of the sludge cyclones. Several of the cyclones at Buffalo have been lined with a ceramic known as "packing house floor tile," or with quarry tile.

The solution for the wear on the paddles in the mixers appears to be a paddle with easily replaceable abrasion resisting tip.

Changes made to one cage mill at Buffalo illustrates current standard practice. In order to provide for more economical maintenance, the housing was built to allow for rapid dismantling and provision made to pull the agitator mill out on rails for inspection or adjustment. The need for this was demonstrated as the rods on the rotor and stator were subjected to severe abraison. As first rebuilt, the rods in the cage mill were protected with high manganese steel but these were expensive and wore out rapidly. A second development using a double, extra heavy, 1¼-in. steel pipe sleeve over a ¾-in. gave more economical results. With further experience, it is indicated that the most economical design is to supply 0.40 carbon steel bars and to build them up with stellite or other hard facing material as wear occurs.

The fuel pipelines initially installed at Buffalo have been removed and have not been used subsequently at other plants. The standard type of sludge feeder now consists of a duct from the drying cyclone to a screw conveyor which feeds the sludge burner.

The induced draft fans as originally installed were on the dirty air side of the ash cyclone. The fans wore rapidly and repairs and replacements were difficult to make. When these fans were moved to the clean air side of the ash cyclones, the wear due to abrasion by sand in the ash was largely eliminated.

The initial installation of pneumatic equipment for ash removal included a cyclone bag filter and vacuum pump. With the temperature of the ash at 1,100-1,113 deg. F., the bags in the filter burned out and the vacuum pump became plugged with ash, a problem solved by installing a second cyclone in place of the bag filter and a steam ejector in place of the vacuum pump.

Springfield, Mass.

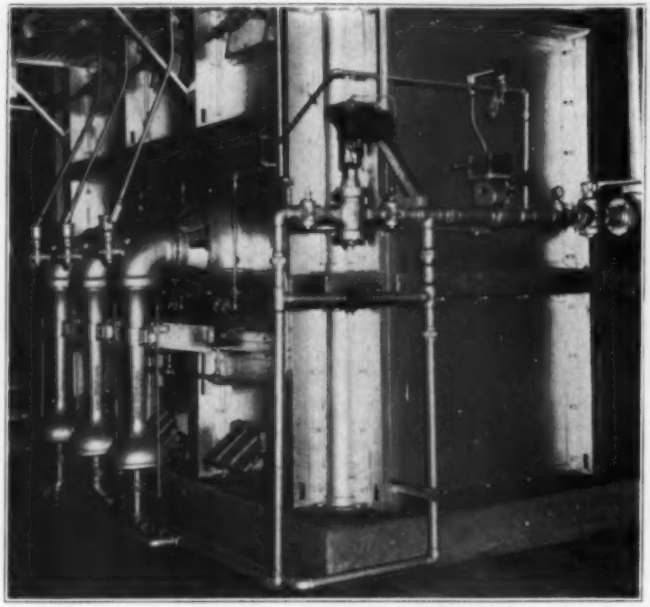
The unit at Springfield has a rated capacity of 10.5 tons per day dry weight of digested sludge solids per 24 hr. when drying sludge cake containing 67.5 per cent moisture with 50 per cent volatile dry basis. During the 10 years 1941-1950, inclusive, the unit was operated on the average of 1,411 hr. per year or approximately 5.6 hr. per work day for a 5-day week, while handling the total sludge production. The average moisture evaporated was approximately 750 lb. per hour of operation. The auxiliary fuel in the form of sludge gas used for burning the sludge amounted to about 650 cu.ft. per 1,000 lb. of moisture evaporated. This is reported for conditions in which there is an abundance of sludge gas at the plant and where it is not necessary to take particular care in the conservation of fuel at the incinerator.

During the years 1943 and 1944, the sludge was dried for fertilizer but in other years the market was not favorable enough to warrant drying operations and expense.

As in the case with Buffalo, the drying cyclones were initially lined with steel plates. They have subsequently been relined with a mortar of lumnite cement and trap rock. The life of the paddles in the sludge mixers has been extended by adding a facing of abrasion resisting materials by means of electric welding.

John P. McDonald, sewage treatment plant engineer, at Springfield, reports complete satisfaction with the installation after 10 years of operation. He states one of the advantages of this type of equipment is the facility with which it can be started up without undue delay in preheating or without burning fuel during nightly or

LOS ANGELES, Calif. Hyperion plant—Four units for digested activated sludge



HOUSTON, Tex.—Two units for activated sludge

weekend shut-downs. The practice of burning during the day shift only and with no heating during the standby period has not resulted in evident damage to the furnaces.

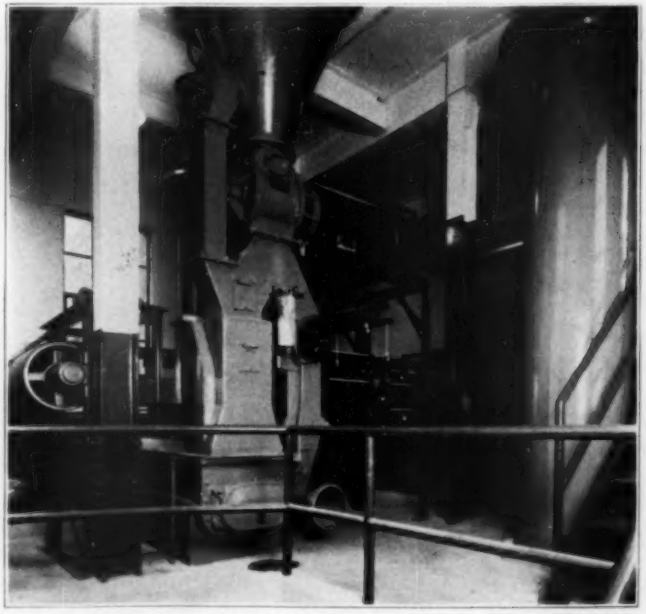
San Diego, Calif.

The first C-E Raymond unit at the San Diego plant was placed in operation during 1943. This unit has a rated capacity to evaporate 3,500 lb. of water per hour. Enlargements to the plant which were commenced in 1948 included an additional flash dryer with a capacity of 5,000 lb. of water exaporated per hour.

The experiences in operation at this plant due to wear from quantities of sand in the sludge removed have been somewhat similar to those at Buffalo.

One of the problems that has been peculiar to the San Diego plant has been the prevention of explosions which would occur from time to time during the shutdown period. In accordance with the manufacturers' recommendations, facilities have been provided to permit flooding the system with steam during shutting down procedure or at times of power failure. The same protection can be afforded by the injection of water through fog nozzles. The manufacturers have commented that this system, in common with all flash drying systems, is equipped with a relief vent on top of the cyclone. They state that this relief vent will safely relieve explosions of any kind and without any danger to the operating staff. This latter is evidenced by the fact that over 10 to 12 years' experience with operation of these plants there is no reported case of damage to the equipment or injury to an operator from such source. However, it is reported that these "puffs" are demoralizing to operating personnel and the manufacturers state that provisions for injection of steam or water is a simple and convenient way of rapidly cooling down the system without damage to the equipment or furnace and is a very desirable convenience. At San Diego, the injection is made at the entrance to the dryer cyclone and cage mill.

The new installation includes a reinforced concrete brick-lined exhaust tunnel and 150-ft. stack for removal of dryer gases. There have been several fires in the tunnel and lower part of the stack. It appears that the operation of water sprays throughout the length of the tunnel and at the bottom of the stack has eliminated this difficulty. It is reported that the trouble in the tunnel was due to build-up of grease from ¼ to ¾ in. in thickness. This matter of grease in the sludge is an ever increasing problem in the operation of sludge handling and disposal units since the end of World War II. It is generally believed to be the result of the increasingly wide use of detergents. The manufacturers report that this trouble is not confined to any one plant or one location but that it is rather general. A



STAMFORD, Conn.—Flash drying system in connection with garbage and refuse incineration

SPRINGFIELD, Mass.—Drying and incineration for digested sludge

grease content in the dry sludge up to approximately 8 percent will give no trouble. However, when this percentage is substantially exceeded, the very low temperature volatile fractions of the grease are distilled off and will condense on any cool surface. If not continuously removed, it may be ignited at some time during the period of the shutdown of the system. To preclude such the safe thing to do is to clean this part of the equipment either continuously by the use of water sprays or periodically by scraping.

A further reference to this problem of grease accumulation is given in the discussion of the operation of the Los Angeles plant.

Eric V. Quartly, superintendent of the San Diego sewage treatment plant, reports that while many operating problems have been experienced with the flash dryers during past years, he does not wish to convey the impression they are unsatisfactory for the purposes intended. On the contrary, he states these units are giving excellent service at the present time.

Los Angeles

The flash drying and incinerating equipment at the Los Angeles Hyperion plant includes four units each having a capacity to evaporate 22,500 lb. of moisture per hour from sludge cake containing 25• percent solids. Each unit was specified to be capable of incinerating all or any portion of the material dried by it.

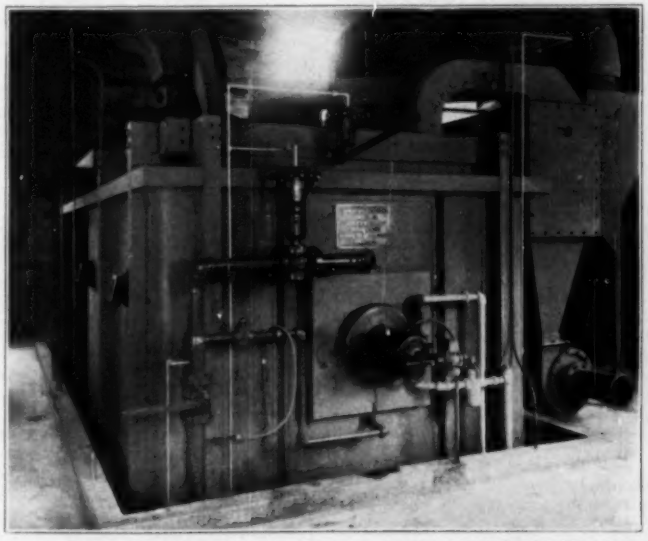
The equipment was first placed in operation during August, 1950. In a recent operational test conducted by the City, the average evaporation was 22,280 lb. of water per hour while producing fertilizer at the rate of 8,670 lb. per hour with an average filter cake load of 31,700 lb. per hour. The dryer inlet temperature was 1,112 deg. F. as compared with a design temperature of 1,300 deg. F. It is possible that if the design temperature was maintained at the dryer inlet, the evaporative capacity would be well in excess of the guaranteed figure.

During the month of May, 1951, the dryers reduced all of the filter cake produced at the plant to fertilizer, amounting to 4,000,000 lb. for the month (moisture content 7 percent). Since the dryers were operated for only 23 percent of the time, there was no need to operate them at their rated capacity. The average moisture evaporated was 14,550 lb. per dryer. The dryer units at this plant have indicated that they can take care of all of the sludge produced on a design basis and with one spare unit.

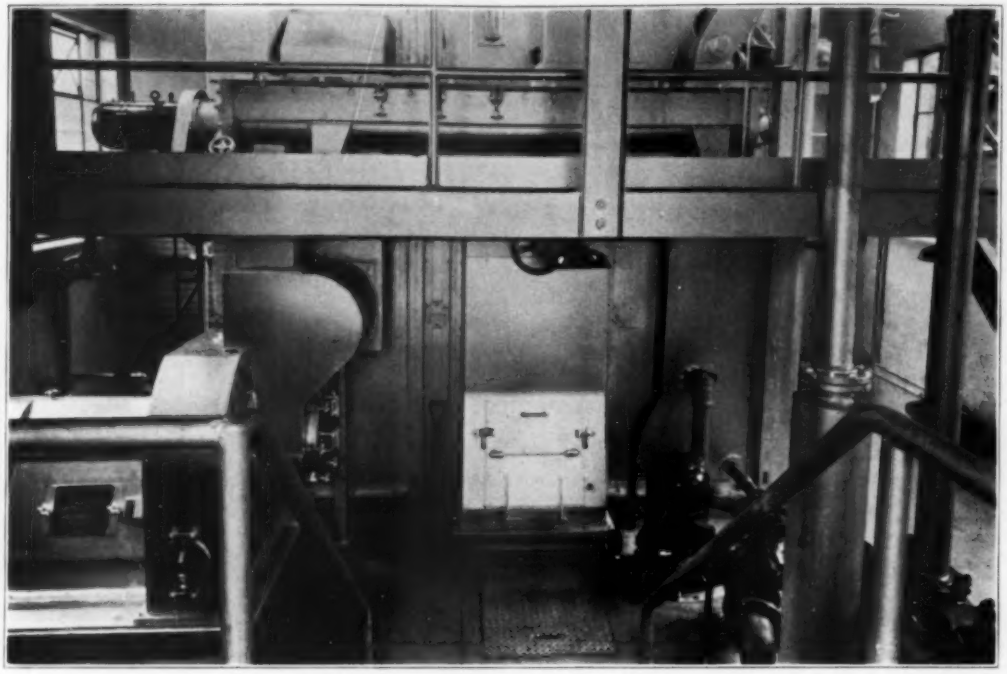
As at the San Diego plant, there is some evidence of accumulation of grease which appears to have occurred when the digested sludge contained a reported average of 15 percent grease. Recently, the temperatures within the digestion tanks have been raised from an average below 90 deg. to about 95 deg. At the higher temperature, it appears that the grease content in the digested sludge will average approximately 5 percent. It is hoped that this will eliminate in large measure the grease problem on the walls of the flash drying equipment.

Summary

GENERAL. Equipment handling sewage sludge should be so designed as to resist wear from the abrasive



SHEBOYGAN, Wis.—Flash drying system for digested sludge fertilizer



CUYAHOGA FALLS, Ohio—Small flash drying and incineration unit for raw sludge

particles contained therein. Parts subject to wear should be readily replaceable or provision made to build up the worn parts with abrasive resisting materials.

PREHEATERS. Adequate provision should be made for cleaning, maintenance, and repair of preheaters in connection with flash drying furnaces.

MIXERS. The mixers designed for mixing dried sewage with wet sludge cake should have abrasive and corrosion-resisting liner plates. The paddles should be of meehanite or other steel alloy capable of resistance to wear at high temperatures. Shafts and paddles should be readily replaceable and it is desirable to supply the paddles with easily replaceable abrasive resisting tips.

CAGE MILLS. The inlet end of the cage mill should be lined with a corrosion resisting alloy. The cage mill should be of quick-opening design in which the rotor and pedestal may be rolled back on a track thus facilitating the replacement of liner plates and the replacement of cage bars.

INDUCED DRAFT FANS. These fans should be installed on the clean air side of the ash cyclones where practical.

DUCTS. The ducts and pipes carrying sludge in suspension should be fabricated in easily removable sections. The bends should be provided with removable wear backs lined with abrasive resisting material such as chrome ore.

PURGING SYSTEM. A suitable system of water or steam purging for prevention of explosions in the system should be provided.

CYCLONE SEPARATORS. A lining is required which will resist abrasion. A 2-in. gunite mixture of lumnite cement and trap rock appears to be suitable for this purpose.

STACKS. It appears desirable to line chimneys taking the discharge from the flash dryers and incinerator with firebrick for at least the lower ⅓ of their height. Consideration should be given to the fact that occasional high temperatures may occur in the operation of incineration equipment.

FLY ASH REMOVAL. Fly ash may create a serious problem in the gas discharged from the fly-ash drying systems unless appropriate means are provided for its removal. It has become increasingly necessary in the case of new installations to comply with stringent fire, smoke and air pollution ordinances. Enlarged ducts, settling chambers or inertia separators seldom would prove to be satisfactory.

Mechanical dust removal equipment such as the Multiclone type as manufactured by Western Precipitation Corp. or the fly ash collectors using the Van Torgeren system as manufactured by Buell Engineering Co., or the Thermix Controlled Multi-Clone type as manufactured by the Pratt-Daniel Corp. usually afford satisfactory results for this service. However, in some cases, a higher degree of treatment must be provided for the removal of fly ash, such as electrostatic precipitation.

This latter type of equipment must be carefully designed to permit access for cleaning. If continuously high efficient removal of fly ash particles and smoke is required, sufficient units for fly ash removal must be provided so that one unit may be taken out for repair and maintenance.

Acknowledgment

Acknowledgment is gratefully made for data supplied by John P. McDonald, Sewage Treatment Plant Engineer, Springfield, Mass., Eric V. Quartly, Superintendent, Sewage Treatment Works, San Diego, California, and to C. W. Gordon, Manager, Flash Dryer Division, Combustion Engineering-Superheater, Inc.

N.Y. and New England Associations Hold Fourth Joint Meeting

Industrial waste treatment and effects of such wastes on sewage treatment featured.

A Report

by HARRY A. FABER*, *Editorial Associate, Water and Sewage Works*

THE fourth joint meeting of the New York Sewage and Industrial Wastes Association and the New England Sewage Works Association held in Springfield, Mass., on June 7-8, 1951, was a technical and social success. Registration totaled more than 265. Sharing the honors as presiding officers were President William S. Wise of the New England Association and President John M. McCrea of the New York Association.

Executive committees of the two associations met during the evening preceding the sessions, first for a joint dinner, and then separately for business meetings. The New England group announced plans to vote at its fall meeting on a change of title to "New England Sewage and Industrial Wastes Association."

Guest speakers at the joint meeting luncheon were Hon. Daniel B. Brunton, Mayor of Springfield, and W. H. Wisely, Executive Secretary, Federation of Sewage and Industrial Wastes Associations. Mayor Brunton extended a cordial welcome to the meeting, and "Pete" Wisely discussed Federation affairs with particular reference to the new claimant agency assigned to serve "for municipal and industrial water supply and sewage and industrial waste disposal."

A Social Hour followed the technical sessions on the first day of the meeting, by courtesy of the Water and Sewage Works Manufacturers' Association, Inc. A special showing at the Springfield Planetarium for members and guests of the Associations, provided the evening entertainment. The ladies' program included a bus trip to historic Northampton, with luncheon at the famous Wiggins Tavern.

Following breakfast on the second day of the meeting, the entire technical program was devoted to an Operators' Round Table discussion titled "The Three R's of Sewage Treatment." The concluding feature of the meeting was a planned luncheon at Storrowton Village, a tour of the village, and an inspection of the Springfield Main Sewage Treatment Plant.

Chairman of local arrangements was John D. McDonald, Supt. of the sewage works at Springfield. The technical program was jointly planned by committees of the two associations headed by J. H. L. Giles of the New England and H. A. Faber of the New York Association.

J. M. MacCrea
Mfr's. Agent
Chi. Pump Co.
Syracuse, N.Y.
(President)

W. R. Schreiner
Dist. San. Engr.
St. H'lth. Dept.
Glens Falls, N.Y.
(Vice President)

N.Y.S. & I.W.A.

R. C. Sweeney
Dist. San. Engr.
St. H'lth. Dept.
White Plains, N.Y.
(Exec. Secy.)

W. S. Wise
Chief Engr.
St. Wat. Comm.
Hartford, Conn.
(President)

E. S. Chase
Cons. Engr.
Metcalf & Eddy
Boston, Mass.
(1st Vice Pres.)

N.E.S. W.A.

W. E. Merrill
Pub. W'ths. Engr.
St. H'lth. Dept.
Boston, Mass.
(Secy.-Treas.)

Technical Program

Radioactivity and Sewage Problems

"SEWAGE WORKS ASPECTS OF RADIOLOGICAL PROBLEMS," by LeRoy W. Van Kleek, Principal Sanitary Engineer, Connecticut State Department of Health, Hartford, Conn.

Using for background material, data from the radiological health training course of the USPHS, which he attended, Mr. Van Kleek discussed and defined fundamental aspects of radioactivity with radiac instruments of nuclear fission. The monitoring of radioactivity with radiac instruments will be applicable to measurement of cumulative exposure of personnel and to detect contaminants in air, water, milk, food, and sewage.

One instrument described is the radiac scaler or counter which might be likened to sewage flow recorders for Parshall or Venturi flumes. As the flow recorders register the quantity of flow in a given time interval, a scaler or counter registers the quantity of radiation. Portable Geiger survey meters are suitable for measuring permissible emergency radiation levels in sewage.

Although a variety of excellent and sensitive radiac instruments are available for various specific purposes in radiological work, the entire instrument field is under intensive development. New and improved instruments will probably be considerably simplified, more rugged, and much lower in cost.

Radioactive matter from isotopes in peace time, or as a result of radiological warfare or atomic bombing, may contaminate sewage. It cannot be destroyed or rendered harmless by any chemical means such as neutralizing or disinfecting. It must be re-

* Research Chemist, The Chlorine Institute, N. Y. City.

moved by physical means or rendered harmless by dilution to reduce the intensity of radiation to a safe level. Activated sludge treatment and chemical coagulation appead to be methods of varying effectiveness in radioactivity removal, but the sludge produced in each type of treatment is then radioactive and presents a problem of safe disposal.

About the only practical treatment now known for such wastes in streams is natural decay or extreme dilution. Sewage works officials and operators will need experience in the use of radiac instruments, as a minimum, to meet problems in the radiological field. Training courses must be utilized to meet this need.

in detail on an investigation of the velocity constant of effluent from the Minneapolis-St. Paul sewage treatment plant and of the effect of the effluent on the Mississippi River. In this study two basic points became clear: (1) No lag phase or immediate oxygen demand was evident, and (2) no appreciable nitrification took place until the 13th day of incubation. The velocity constant was established on the basis of the ratio between the 1 and 3 and the 3 and 5 day B.O.D. values.

Raw influent sewage at the plant had a k value of 0.162, effluent sewage had a k value of 0.192, and the river water reached a k value very close to 0.1—but only after oxidation had passed its critical period. The

hours) are acid (pH value 3.8 to 4.2) and require neutralization with lime (about 3,000 lb. per day). The floc formed is largely removed in a clarifier and the effluent is discharged to a lagoon; the final discharge to a river has a pH value of 8.2 to 11.0. Sludge from the clarifier is pumped to a separate lagoon and is dewatered by loss through cinder walls of the dyke. The treatment is well controlled, costs about $5,000 per year for chemicals and operation, and has made the river safe for stocking with trout.

Plating wastes at the Electrolux Corp. are coagulated by applying about 1.5 lb. of sodium metabisulfite and 4 lb. of lime per 1,000 gal. of waste, then settling in eight sedimentation units equipped with propeller

More Brass Hats

E. L. Bond
Supt.
Str. & Sew. Dept.
Greenfield, Mass.
(N.E. 2nd V.P.)

W. H. Brown
Engineer
Builders-Prov.
Providence, R.I.
(N.E. Fed. Dir.)

J. C. Brigham
San. Engr.
St. H'lth. Dept.
Albany, N.Y.
(N.Y. Treas.)

J. D. McDonald
Supt.
Sew. Treat.
Springfield, Mass.
(Loc. Arrangements)

Program Chairmen

J. H. L. Giles
San. Engr.
St. H'lth. Dept.
Hartford, Conn.
(N.E.S.W.A.)

H. A. Faber
Res. Chem.
Chlor. Inst.
New York City
(N.Y. S&IWA)

B.O.D. Load on Streams

"THE RELATION OF B.O.D. TO STREAM DEOXYGENATION," by Walter E. Williams, Sanitary Engineer, American Cyanamid Co., Pearl River, N. Y.

The B.O.D. test has long been our measuring device for the oxygen demand load imposed on a stream. Mr. Williams described a stream as a complex entity, and the test method must accordingly be complex. The available food supply determines the rate of oxidation.

A velocity constant for the rate of oxidation has been developed from the Phelps formula and the Velz method of graphical representation may be employed. The commonly employed value of $k = 0.1$ at 20°C, as the velocity constant applies only to the carbonaceous oxygen demand phase. The 5 day B.O.D. value is usually not significantly affected by the nitrification phase which follows the carbonaceous phase. The immediate oxygen demand, generally due to chemical constituents, and a lag period caused by toxic substances, may further affect the results of the test.

In relating B.O.D. to stream deoxygenation, Mr. Williams reported river investigation included regular sampling over a 90 mile length of flow during the period 1944 to 48.

Results of the study indicate the use of $k = 0.1$ for the velocity constant in normal streams to be a safe assumption. However, where industrial wastes are involved in stream B.O.D. studies, the k value cannot be assumed but must be separately determined. Mr. Williams gave credit to the Minneapolis-St. Paul plant laboratory, headed by K. L. Mick, which provided the many analyses making the study possible; and to Prof. George J. Schroepfer of the Univ. of Minnesota for direction of the investigation.

A Variety of Industrial Wastes

"REVIEW OF SOME INDUSTRIAL WASTE TREATMENT PLANTS IN CONNECTICUT," by Willis J. Snow, Senior Sanitary Engineer, Connecticut State Water Commission, Hartford, Conn.

Mr. Snow pictured the treatment experience with a number of different industrial wastes in his state, giving operating details, costs, and returns to the industry.

Metal pickling wastes at the Gilbert Mfg. Co. (about 200,000 gal. per 24

type stirring mechanism. Sludge is removed by a trailer tank for disposal to drying beds at the local sewage treatment plant. Operating costs for chemicals and labor are about $3,000 per year, and a high quality of effluent is maintained.

Metal treating wastes containing cyanides are treated at one plant by oxidizing with chlorine under alkaline conditions. Chlorine is added directly to the wastes (in the chlorinator ejector) and caustic soda is used for maintaining a pH value of at least 8.0, using a continuous pH indicating meter. The chlorine requirement varies from 65 to 100 lb. per day and caustic is of about the same amount. After two hours detention, a residual of 2.0 ppm. chlorine is required (the waste may be returned from settling tanks for reprocessing if necessary). Operation of the plant, treating 80,000 to 90,000 gal. per 24 hours, costs about $8,000 per year.

White water from paper board mills is generally treated by sedimentation. With good pH control, suspended solids removal of 82 to 95 per cent is accomplished. Deaeration systems may be used for removal of solids by flotation. All progressive pa-

per mills now reuse as much process water as possible. Installation costs of the treatment plants is found to vary from $50 to $150 thousand dollars, depending upon plant size.

One Company—Many Problems

"INDUSTRIAL WASTE TREATMENT DEVELOPMENTS IN THE GENERAL ELECTRIC CO." by K. S. Watson, Chemical Engineer, General Electric Co., Schenectady, N. Y.

The company-wide program of this organization, as described by Mr. Watson, includes provision of technical counsel to all plants and branches. Encouragement is given toward meeting community obligations with assistance from company management. In all new construction projects, pollution control action is one of the first steps.

Four phases of the program described in detail include: (1) definition and investigation, (2) in-plant reduction of waste, (2) construction of treatment facilities, and (4) an educational program for plant personnel.

Mr. Watson reviewed several recent waste treatment installations of the General Electric Co. At the Erie, N. Y., works, metal finishing wastes are segregated into four types: Cyanide wastes are treated with chlorine and lime; chromium wastes with sodium metabisulfite or ferric sulfate; concentrated acid wastes are neutralized with lime slurry and ferric sulfate; and wastes and fly ash are employed for sludge conditioning, and the sludge is used for land fill.

At the Brockport, N. Y., works acid and metal wastes are treated separately from alkaline wastes; the pH value of all wastes is automatically controlled; effluent is discharged to the Barge Canal; and sludges are stored in a lagoon.

At Philadelphia, Pa., plant wastes are neutralized to pH5 before discharge to municipal sewers. Upflow limestone beds are utilized for treating plating wastes (at a rate of 20 gal. per sq. ft. per min.) Pretreatment of wastes sent to city sewers is also practiced at the Lockland, Ohio, and Louisville, Ky., works.

Symposium on Industrial Wastes

"PROBLEMS CAUSED BY INDUSTRIAL WASTES AT SEWAGE TREATMENT PLANTS," a symposium with George E. Symons, Managing Editor, *Water & Sewage Works*, New York, N. Y., as leader.

Dr. Symons introduced a series of prepared discussors, and guided the open discussion of problems caused by varied industrial wastes received at sewage treatment plants.

CHEMICAL WASTES were discussed by Edward J. Smith, Supt., Sewage Treatment Plant, Niagara Falls, N. Y. This is a chemical manufacturing city, and 85 per cent of the total sewage flow is industrial waste—the largest percentage of this, however, is cooling water. The industries use Niagara River water, returning wastes of even greater volume to the sewers; the wastes may completely mask the domestic sewage.

Special problems are caused by chemical wastes not soluble in water and by those having a high chlorine demand. Many wastes contribute gaseous constituents which are liberated by aeration (dropping of flows within the plant), the volatile material is frequently of lachrymatory type which causes difficulty to plant personnel in spite of a powerful ventilating system. A free chlorine residual of 300 ppm. is frequently present in the incoming sewage (maximum to date is 800 ppm.). At times the B.O.D. may average about 50 ppm. in both influent and effluent.

Slowly developing is a cooperative effort, involving contributing plants and the civic authorities, directed toward mitigation of extreme industrial waste problems. One manufacturer is installing separate waste treatment facilities to include chlorination of cyanides and removal of dust from plant operations, with discharge of effluent directly to the river.

METAL WASTES received at the New Britain sewage treatment plant were discussed by John R. Szymanski, plant superintendent. The Guggenheim process is employed at this plant.

Pickling wastes are a problem of long standing, the raw sewage frequently containing from 500 to 750 ppm. of iron. Industries discharging these wastes cooperate to the extent of providing storage and discharging the wastes uniformly. The treatment process depends upon combined use of air and iron salts, but cannot operate well with too much iron (50 to 60 ppm. is considered most suitable). One industrial plant finds the crystallization of iron salts profitable in providing a commercial product which can be sold to the sewage treatment plant.

The problem of cutting oils in the raw sewage is largely solved by use of a preliminary flotation tank. The scum produced is disposed of on the plant dump and is covered with incinerator ash.

PENICILLIN WASTES impose a considerable load on, but can be handled by activated sludge treatment—this was the theme of a discussion by Uhl T. Mann, Supt., Ley Creek Sewage Treatment Plant, Syracuse, N. Y. The Ley Creek plant was handling such wastes while early, and contradictory, results were being obtained in experimental studies.

Each step in the manufacture of penicillin contributes detrimental wastes. Originally B.O.D. and suspended solids content of these wastes were as high as 30 to 50 thousand ppm.: these values have been successfully reduced by stripping operations to 5,000 and 3,000 ppm. respectively.

Symposium Leaders

F. L. Flood
Cons. Engr.
Metcalf & Eddy
Boston, Mass.
(Operation)

Geo. E. Symons
Man. Editor
Wat. & Sew. Wks.
New York City
(Ind. Wastes)

Programmers

L. W. VanKleeck
Prin. San. Engr.
St. H'lth. Dept.
Hartford, Conn.
(Radioactivity)

W. J. Snow
Sr. San. Engr.
St. Wat. Comm.
Hartford, Conn.
(Ind. Wastes)

K. S. Watson
Engineer
Gen. Elect. Co.
Schenectady, N.Y.
(G.E.'s Wastes)

E. J. Smith
Supt.
Sew. Treat.
Niag. Falls, N.Y.
(Ind. Wastes)

The removal of formaldehyde is another manufacturing operation found essential to permit activated sludge treatment of wastes (in this instance, to enable digesters to function). By the control or elimination of toxic materials, the Ley Creek plant has functioned as long as loading is not beyond tank capacity (as much as 2 to 3 times the design loading has been handled).

Chlorination of return activated sludge has proven an aid to operation, as has an increased sludge bed capacity—the latter built at cost of the manufacturer. In the treatment of penicillin wastes, cooperation of the manufacturer in testing for the presence of solvents, in the removal of constant problem in this application. The variable flows and special textile wastes constitute a large problem in chlorine dosage control, in order that a uniform residual may be maintained. Rate charges, for the treatment of industrial wastes, have been established on the basis of primary treatment as about $105 per mil. gal.

E. SHERMAN CHASE, Partner, Metcalf and Eddy, Boston, Mass., closed the symposium by recalling experience at widely scattered treatment plants. At Fostoria, Ohio, iron pickling liquors clogged trickling filters; at Rahway, N. J., penicillin wastes stopped digestion; at Akron, Ohio, rubber wastes doubled the suspended solids load from the remainder of the city; and at Jeanette, Pa., the brewery wastes proved to be the tail wagging the dog.

courage their preparations and publication.

Mr. Cramer cited the methods by which such reports serve to advance the art and knowledge of sewage treatment, and suggested the wider exchange of reports, especially among plants employing the same type of treatment.

Recording and *Reporting* were discussed from other aspects by various round table participants. PROF. GAIL P. EDWARDS, New York Univ., cautioned that records must be accurate and mean what operators intend them to mean. W. G. SWEENY, Dir. of Labs., Nassau County Dept. of Health, recommended submission of reports to the Federation Journal, to provide the maximum dissemination of information. M. T. HILL, Dist. San. Engr., St. Dept. of Health, Montgomery, N. Y., cited the utility of plant operation reports submitted to District Engineers of the State Health Department: the reports are reviewed and compared with other plant reports—frequently with resulting correction or improvement in operation.

REPAIRING was the subject of a detailed paper presented by Richard C. French, Asst. Civ. Engr., Dept. Pub. Wks., New York City, and based on routine procedures observed in the sewage treatment plants of New York City.

It is to be hoped that this paper will be published in full, as it provides an unusual record of what might be termed "the operating life expectancy before repair" of so many plant units. The record covered sewage pumps, blowers, gas engines, diffuser plates, venturi tubes, chlorinators, digestion units, and recommendations for protective coatings.

A. J. SCANLON, Civ. Engr., Dept. of Pub. Wks., New York City, pointed to the value of equipment operation records for New York City to establish budget requirements. This budget

J. R. Szymanski
Supt.
Sew. Treat.
New Britain, Conn.

Uhl T. Mann
Supt.
Ley Creek Plant
Syracuse, N.Y.

J. M. Brown
San. Engr.
Lederle Labs
Pearl River, N.Y.

F. J. Cramer
Supt.
Town of Greece
Rochester, N.Y.

Panel Participants

G. P. Edwards
Prof. San. Chem.
New York Univ.
New York City

E. F. O'Brien
Cons. Engr.
Syracuse
N.Y.

toxic constituents, and in the maintenance of a uniform discharge rate are all important contributions.

AUREOMYCIN WASTES, described by James M. Brown, Jr., San. Engr., Lederle Laboratories, Pearl River, N. Y., impose a varied load on the municipal sewage treatment plant.

Especially important wastes from the manufacture of this antibiotic are fermentation beers of high B.O.D., inorganic compounds including filter aid (which collect in digesters), and chemical wastes. The chemical wastes are especially significant: while the solvent butanol is recovered in the manufacturing plant, a residual amount of 0.5 per cent (representing excellent recovery) still contributes 60,000 ppm. B.O.D.

TEXTILE WASTES have created a treatment problem at the Blackstone Valley, R. I., sewage treatment plant according to Charles G. Hammann, Director and Ch. Engr., Blackstone Valley Sewer Dist.

This plant is still under construction, but two temporary chlorinating stations are in operation for the disinfection of effluents. Screened treated sewage is used for chlorinator operation and waste textile fibers are a

Operators' Round Table

"THREE 'R's' OF SEWAGE TREATMENT (RECORDING, REPORTING AND REPAIRING)" an operators' round table with Frank L. Flood, Partner, Metcalf and Eddy, Boston, Mass., as leader.

RECORDING was discussed by Robert H. Cummings, San. Engr., Westchester County Dept. of Health, White Plains, N. Y.

Plant records represent an accounting to supervising authorities, a report on its proper functioning, and a basis for improvements. The details involved in making a report do all these things were clearly described by Mr. Cummings.

REPORTING, according to Francis J. Cramer, Supt., Sewage Treatment Plant, Greece, N. Y., has significant value in bringing records to public attention as well as utility for operators. According to statistics, less than 10 per cent of all sewage treatment plants submit an annual report in spite of awards (not based on the size or complexity of the plant) designed to en-

Photo by Springfield Rep. & Daily News.

Very Important Persons

N.Y. Assn. President John MacCrea, W. H. Wisely, Exec. Sect., Fed. S.&I.W.A. (Luncheon Speaker) and N.E. Assn. President W. S. Wise.

is compiled as much as 18 months before the fiscal year and accurate prediction of needs is essential.

Several participants in the round table cited difficulties in the operation of plug valves: to remain operable these must be kept lubricated, they should be turned at least monthly, and when frozen a solvent termed "Liquid Wrench" has been found successful.

Proper installation and maintenance of equipmnt should be a primary concern of the contractor, manufacturer's representative, consulting engineer, and plant operator. These preliminary precautions will do much to reduce the frequency and extent of repairs required.

Alabama Water and Sewage Assn's Sixth Short School*

The Sixth Annual Short School and Conference of the Alabama Water and Sewage Association was held at the University of Alabama, Tuscaloosa, Ala., June 11-15. One hundred thirteen registrants attended. This was the first year in which examinations for voluntary certification of water plant operators were held; the first four days were devoted to class and laboratory sessions and examinations followed.

Subjects covered in the Class II sessions included Bacteriology and laboratory work; Corrosion Control; Water-borne Diseases; Cross-connections; and Watershed Protection.

Other topics included Disinfection and Theories of Sanitation; Theories of Coagulation; Filter and Wash Rates; Calculations and Records; Interpretation of Bacteriological Reports and Tastes and Odors.

Class III operators had lectures and laboratory on Chemistry and Laboratory Procedures; Simple Hydraulics; Tastes and Odors; Red Water and Its Control; Operation and Repairs to Gas Chlorinators; and Filtration Plant Equipment.

Class IV operators' classes presented Pumping Plant Equipment, and Operation and Repairs to Hypochlorinators.

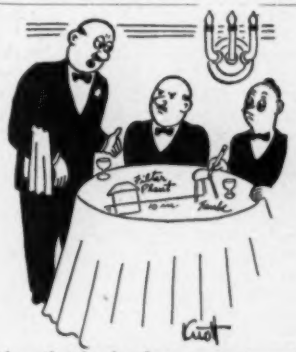
Examinations resulted in 42 men being certified for certificates in various classes.

Sewage plant operators heard papers on "The Sewage Plant Operator", and "Stream Sanitation and Sewage Treatment in Alabama" and participated in a discussion of primary and secondary treatment of sewage and laboratory control of sewage treatment plants.

No plan for the certification of sewage plant operators has been adopted, but the committee on sewage plant operators' certification, was instructed to present a plan for certification of these operators at the next meeting.

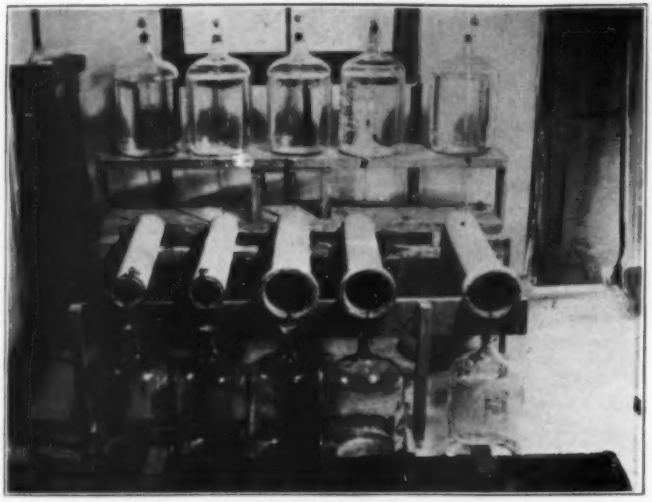
At the general session A. N. Beck, Ala. State San. Engr., presented a paper on "Fluoridation." This was followed by a discussion of the affairs of the Federation of Sewage and Industrial Wastes Association, by R. E. Fuhrman, President of the Federation. Dr. Eric Rodgers, head of the physics department, University of Alabama, discussed "Atomic Radiation" after which the subject of "Civil Defense" was presented by Clarence Simmons of the State Civil Defense department.

The following officers were named at the business session: E. E. Love, Tuscaloosa, Ala., president; Curtis Hammond, Gadsden, Ala., vice-president; Alex O. Taylor, Auburn, Ala., re-elected secretary; G. H. Dunstan, University, Alabama, re-elected treasurer; C. W. White, Montgomery, Ala., re-elected editor of the Official Bulletin; John C. Clarke, Montgomery, Ala., director, Federation of Sewage and Industrial Wastes Associations. Mr. Clarke was also named to receive the Federation's Arthur S. Bedell award.



"I know that the plans for our new water-works are important; but, our laundry says that they are tough to get out of the cloths."

*A report by Prof. Gilbert S. Dunston, Univ. of Ala., Treas. of Ala. Water & Sewage Assn.



TEST ASSEMBLY for study of acid attack. (Fig. 1).

Corrosion of Cement-Bonded Sewer Pipes

By acid and alkaline solutions

by HARVEY F. LUDWIG *and* RUSSELL G. LUDWIG*

A SUBJECT of much current interest to sanitary engineers is the deterioration of cement sewer pipes when contacted by corrosive solutions. When sulfides are generated in the sewage flowing in the pipe, the inside pipe wall above the flow line becomes subject to acid attack. Some of the sulfides escape from the flowing sewage into the space above the flow, and are there oxidized through bacterial action to form sulfuric acid. This reaction occurs most rapidly in the immediate vicinity of the pipe surface, and in fact appears to be catalyzed by this surface. The acid produced is very weak or dilute, but is unbuffered and therefore very corrosive, and may progressively penetrate into the pipe wall to destroy or inactivate the cement bond which is the basis for the pipe's strength. Another type of corrosion may occur on the outside of the pipe, due to corrosive soil or ground water conditions. High-sulfate ground waters are especially corrosive to all cement-bonded materials.

*Respectively Associate Professor of Sanitary Engineering, University of California, Berkeley; and Sanitary Engineer, Ludwig Bros. Engineers, Pasadena, California.

In order to gain quantitative data on this subject, a series of detailed laboratory tests have been made by the writers, employing specimens of four-inch pipe obtained from five widely-separated manufacturing plants. Three of the specimens were concrete, and two cement-asbestos. The two types of pipes are similar in that both employ Portland cement as the bonding agent, but the remaining ingredients differ. Sand and fine rock aggregate are employed as the filler materials in making concrete pipe, and asbestos fiber together with some very fine silica for the cement-asbestos pipe.

The tests performed may best be classified in series, depending upon the corrosive agent used. These were respectively (1) a dilute sulfuric acid (1,600,900 ppm), (2) a very dilute sulfuric acid (480-10 ppm), (3) a relatively strong sulfuric acid (25,000 ppm), (4) distilled water, and finally (5) a solution of sodium sulfate (10,000 ppm).

Tests Conducted With Dilute Acid

The conditions of this test series were selected to simulate corrosion of the type effected where sulfides are present. The tests were accomplished by passing a dilute sulfuric acid solution through each of the five pipe specimens, by means of the equipment illustrated in Figure 1. Five-gallon bottles were placed at the top and bottom ends of each pipe, to serve respectively as storage and collection receptacles. The upper jar was equipped with a constant-head syphon terminating in a capillary nozzle, which, together with a pinch-valve regulator, made it possible to maintain the dripping at a rate constant and uniform for all five specimens. The selected rate was sufficient to empty the five-gallon supply reservoir in just less than 24 hours, so that each day the two bottles would be interchanged and a new cycle started. The lower end of each pipe was dammed with paraffin and the pipe given a slight slope, so as to result in a flow depth varying from one-half inch at the lower end to zero at the upper end. Paraffin was coated over the lower exposed edges of the cement-asbestos pipes and also over the entire bell portion of the concrete pipes, in order to restrict the area of contact to the pipe interior. The length of pipe barrel contacted was the same in all cases, namely three feet.

The dilute acid solution was prepared from Los Angeles City tap-water derived from Los Angeles River sources, and had the following analysis: Total dissolved solids, 472 ppm; alkalinity, 196 ppm; sulfates, 137 ppm; chlorides, 33 ppm; calcium, 76 ppm; magnesium, 21 ppm; sodium 53 ppm; silica, 24 ppm; and pH, 7.52. Sulfuric acid was added to this water to give an acidity of 1,600 ppm, and this solution was used to commence the tests. After each of the first 20 passes, exactly 95 ppm additional acid was added to each jug, in order to maintain the strength of the recirculated solution at approximately 1,600 ppm. Following the 21st pass this solution was discarded, and a new or fresh 1,600 ppm solution placed into use over the 22nd through the 38th passes. Over this second period of recirculation no extra acid was added, the solution strength decreasing gradually from its original strength of 1,600 ppm to a final value averaging 900 ppm. The 39th through 42nd passes, begun after a four-day lapse, also employed a fresh non-reinforced solution, but this had an initial strength of 1,000 ppm and was prepared from distilled rather than tap water.

Titrations to determine acid consumption or neutralization were made following each pass. The results for all five pipe specimens have been plotted in Figure 2, which shows the accumulated acid neutral-

ized by each pipe over the entire 42 passes. Inspection of these data indicates the following conclusions:

(1) Both types of pipe are readily attacked by the dilute sulfuric acid.

(2) Over the initial period of attack, lasting from one to four weeks, the rates of attack are approximately the same for both concrete and cement-asbestos.

(3) Beyond this *initial* period the cement-asbestos pipe exhibits less resistance to further attack than does the concrete.

(4) For both types of pipe the rate of attack is initially very rapid, then gradually decreases as the period of exposure continues.

(5) For both types of pipe the rate of attack at various acid strengths appears to be approximately the same for all acid strengths from 1,600 ppm to 900 ppm. Also, the accumulation in the solution of dissolved substances derived from the pipe does not appreciably reduce the rate of attack when the solutions were brought up to original acid strength after each pass.

Beginning with the 22nd pass titrations were also made to determine the concentrations of hardness ions (calcium and magnesium) in the recirculated liquid, employing the versenate technique. Figure 3 presents these data, and clearly shows that more and more of the cement is leached into solution as the attack continues. The data confirm the results of the acid titrations; i.e., the cement-asbestos pipe, being more readily attacked than the concrete, yields up a greater amount of cement to pass into solution.

Results With Very Dilute Sulfuric Acid:

Another test series, of the same type as that just described, was conducted with a weaker solution of sulfuric acid. The initial solution strength was only 480 ppm. This was not reinforced and hence decreased after 9 passes to 10-20 ppm, after which a fresh 480 ppm solution was placed into use. A total of four groups of 9 passes each were completed, or 36 passes in all.

Space does not permit graphical illustration of the results, and, moreover, they are practically the same as in the preceding series. The rates of attack were closely the same for the two types of pipe for the first two-week period, and thereafter the cement-asbestos combined with more acid than the concrete. The rates of corrosion for both types of pipe were practically independent of the acid strength over the range 480 ppm down to about 125 ppm. In the range 125-10 ppm the rates were still vigorous but appreciably reduced as the concentration decreased.

Tests Conducted With Distilled Water:

Distilled water can be regarded as an extremely weak unbuffered acid, having even less strength than the weakest solution of sulfuric acid which would form on the exposed interior wall of a sewer pipe in which sulfides are present.

To perform this test a modified technique was employed, illustrated by Figure 4, in which each of the test pipes is rotated continuously at a speed of closely 4 rpm. The pipes in this case were kept level, but furnished with annular wooden plugs fitted into both ends, sealed and coated with paraffin. With these plugs it was possible to maintain a "depth of flow" in the pipe constant at one-half inch. The rotation served to expose a maximum of pipe surface to the distilled water. The solution was dripped into one end as before, and the removal from the other end accomplished by means of a constant-level overflow syphon. Two specimens of pipe were employed (A-1

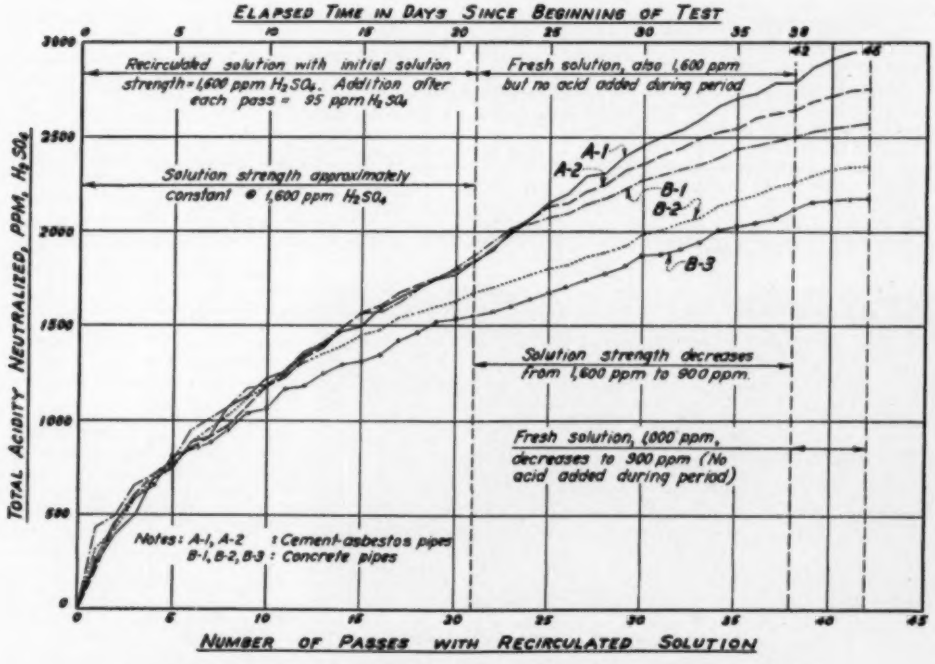

ELAPSED TIME IN DAYS SINCE BEGINNING OF TEST
TOTAL ACIDITY NEUTRALIZED, PPM, H_2SO_4
NUMBER OF PASSES WITH RECIRCULATED SOLUTION
Recirculated solution with initial solution strength = 1,600 ppm H_2SO_4. Addition after each pass = 95 ppm H_2SO_4
Fresh solution, also 1,600 ppm but no acid added during period
Solution strength approximately constant @ 1,600 ppm H_2SO_4
A-1
A-2
B-1
B-2
B-3
Solution strength decreases from 1,600 ppm to 900 ppm.
Fresh solution, 1,000 ppm, decreases to 900 ppm (No acid added during period)
Notes: A-1, A-2 : Cement-asbestos pipes
B-1, B-2, B-3 : Concrete pipes

FIGURE 2: RATES OF ACID NEUTRALIZATION BY CEMENT-BONDED SEWER PIPES CARRYING DILUTE SULFURIC ACID SOLUTION

and B-1), each having a net exposed length of 24 inches. Total hardness titrations were made following each pass, using the versenate method.

The accumulated amounts of hardness ions leached from the pipe specimens are summarized in Table 1, expressed as ppm equivalent $CaCO_3$.

Table 1

After Passage No.	Cement-Asbestos A-1		Concrete B-1	
0	0	pH = 6.20	0	pH = 6.20
1	29		0	
2	35		31	
3	39		---	
4	47		43	
5	54		45	
6	57		56	
7	58		55	
8	65		59	
9	65		61	
10	65		63	
11	71	pH = 8.30	70	pH = 8.37

Tests Made by Suspending Specimens in Relatively Strong Acid:

Tests were made by suspending specimens cut from two of the pipes (A-1 and B-3) in a strong solution of sulfuric acid. Each specimen was a square, 1.5 in. x 1.5 in., the sawed edges of which were coated with paraffin in order to restrict corrosive action to the normal pipe surfaces. Each specimen was suspended by a string into a 1000-ml. beaker containing 900 ml. of 2.5% (25,000 ppm) H_2SO_4. Ten ml. of each solution were titrated after various intervals of time to determine the residual acidity.

The data obtained, in terms of acidity neutralized by the specimens, is contained in Table 2.

Table 2

ACIDITY NEUTRALIZED, PPM H_2SO_4

Elapsed Time Days	Cement-Asbestos (A-1)	Concrete (B-3)
0	0	0
0.8	2,000	1,300
1.0	2,900	2,200
5.0	6,800	5,300
7.0	8,600	7,400
9.0	9,500	8,600
10	10,800	9,600
11	11,200	10,400
12	11,800	11,000

The paraffin coatings on the sides of the specimens served as "windows" through which the depth of corrosion could be observed. Practically all of the corrosion product, in the case of concrete, fell off the specimen and dropped to the bottom of the beaker. In the case of cement-asbestos, all of the corrosion product, although swollen, remained firmly attached to the specimen. It is significant, however, that in the later case the accumulated layer of corroded materials evidently did not serve to diminish the rate of attack.

Figure 5 is a photograph that illustrates the results of this test, by comparing the specimens after twelve days of submersion with uncorroded specimens of the same materials. Notice that the corroded concrete is thinner than the original, and that its scarred surface is clearly indicative of the corrosion effects. The corroded cement-asbestos, however, is actually thicker than the original, and furthermore, although the depth of corrosion is clearly seen from the view of the sawed edges, the appearance of the normal pipe surfaces is scarcely different from the original pipe. This "invisibility" of the effects of acid attack on cement-asbestos may result in false impressions regarding its resistance, particularly in the earlier stages of the attack.

It is significant to note also that examination of the specimens indicated no impairment of the strength of the uncorroded materials. In other words, with both concrete and cement-asbestos, corrosion up to a definite limit of penetration is complete, but the materials immediately past

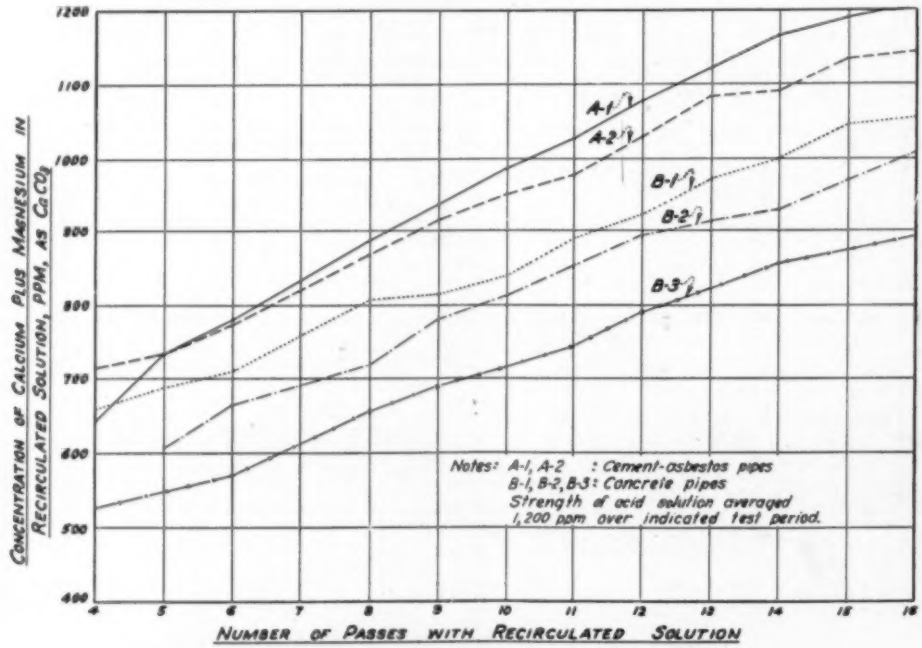
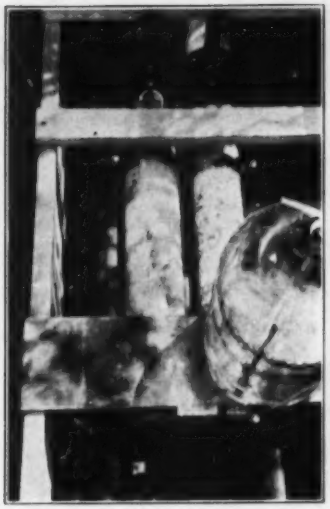


FIGURE 3: RATES OF ACCUMULATION OF DISSOLVED CALCIUM PLUS MAGNESIUM IN SOLUTION RECIRCULATED THROUGH CEMENT-BONDED SEWER PIPES



CORROSION STUDY apparatus for maintaining constant liquid depth in rotating pipes.

that line of demarcation are practically unaffected.

Tests With Sodium Sulfate Solution:

This test procedure was the same as for the distilled water experiments previously described. A five-gallon solution of 1% sodium sulfate was passed repeatedly through 24-inch lengths of pipe continuously rotated at 4 rpm.

Results obtained, expressed as ppm total hardness accumulated in the recirculated leaching solution, are given in Table 3.

Table 3

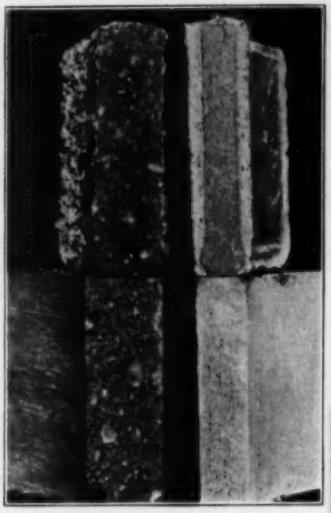
After Passage No.	Cement-Asbestos (A-1)		Concrete (B-3)	
0	0	pH=9.43	0	pH=9.43
1	50		46	
2	79		71	
3	99		88	
4	115		97	
5	127		105	
6	138		118	
7	146		125	
8	150	pH=9.35	130	pH=9.33
9	158		136	
10	160	pH=9.26	137	pH=8.85

Summary and Conclusions:

Specimens of concrete and cement-asbestos pipe have been subjected to chemical attack by leaching the pipe surface with a variety of agents comprising (1) buffered sulfuric acid solutions ranging in strength from extremely dilute (10-20 ppm) to strong (25,000 ppm), (2) distilled water, and (3) a solution of sodium sulfate.

In all cases it was found that the cement bond of both concrete and cement-asbestos pipe was attacked and deteriorated. The amount of corrosion or deterioration increased progressively with increased time of exposure, but with the *rate* of corrosion gradually decreasing with increasing time. The concrete and cement-asbestos behaved similarly, except that the cement-asbestos reacted with the leaching solutions at a somewhat greater rate. This, however, does not necessarily mean that a given thickness of cement-asbestos pipe would have a shorter life than the same thickness of concrete under similar conditions of use, because the cement-asbestoes contains a greater percentage of cement than does the concrete.

As regards the corrosion products, when concrete is attacked these tend to be washed away from the surface, leaving a scarred appearance readily visible to the eye. In the case of cement-asbestos, the corroded materials tend to remain firmly attached to the surface, although in a swollen condition. In the early stages of the corrosion the cement-asbestos surface has an appearance similar to that of uncorroded pipe. The accumulated layer of corroded material appears to offer no protection of consequence to the underlying surface from attack by further exposure.



SPECIMENS of test pieces cut from pipes. Left—concrete; Right—cement asbestos.

Longest Mass Movement of Water Ever Attempted by Man

California's $600,000,000 Central Valley Project of water transference for irrigation began integrated operation after 14 years of construction work.

In transferring surplus water from the Sacramento River Valley to the thirsty San Joaquin River Valley, (the two valleys together measure 500 miles), this development represents the "longest mass movement of water ever attempted by man," according to the Federal Bureau of Reclamation.

Six Worthington centifugal pumps, driven by 22,500 h.p. motors deliver 2,000,000 gallons per minute—a 200 foot lift from the Sacramento River, at Tracy, Calif., sending it into the 120-mile Delta Mendota Canal to irrigate farms in the San Joaquin Valley.

ATTENDANTS AT THE SOUTH DAKOTA SEWAGE WORKS SHORT SCHOOL

A group picture of 56 of the 60 who attended the 1951 Short Course for Sewage Works Operators held at S.D. State College in Brookings, S.D. It was noteworthy that this was the largest attendance at any S.D. Sewage Works Short Course, attendants travelling from over the state. The school is conducted jointly by the S.D. State Dept. of Health (C. E. Carl, Chief Engr.) and the S.D. State College (H. M. Crothers, Dean of Engineering).

TRICKLING FILTER pilot plant strawboard waste treatment, Terre Haute, Ind.

The Strawboard Waste Problem

Considerable has been learned, but much more to be done.

by DON E. BLOODGOOD, *Professor, Sanitary Engineering, Purdue University, Lafayette, Ind.*

THE strawboard industry has long been plagued with problems relative to the disposal of wastes. In fact, one of the first stream pollution offenses to reach the courts of Indiana involved a manufacture of strawboard. It was in 1893 that the Indianapolis Water Co. brought suit against the American Strawboard Co. of Noblesville, Ind.[1] and obtained an injunction in the Federal Court. In 1904 the West Muncie Strawboard Co. was the defendant in the Indiana Supreme Court[2] when it was accused of polluting White River with "deleterious substances".

It was very likely that Sackett and Bowman of the U.S. Geol. Survey started their investigation of strawboard waste disposal[3] as a result of these court cases. Sackett and Bowman tried to adapt the methods of purifying water to the treatment of strawboard wastes. They reported[4] in 1905 on experiments with coagulation with aluminum sulfate, iron sulfate and lime, followed by filtration through sand. The results were not very encouraging.

Phelps took up the investigation and in 1906 reported[5] that he had tried settling with mechanical filtration. Although the results were encouraging, immediate treatment of wastes from the industry was not forthcoming. The Dutch in 1909 experimented with the production of methane from strawboard wastes. Dr. Kessener, however indicated[6] that they were more interested in the gas for fuel than they were in preventing pollution.

In all development work there are peaks of activity and valleys of inactivity. The investigation on strawboard wastes must have been in one of these valleys between 1906 and 1918 because it was not until the latter year that Hommon reported[7] on the testing station at Noblesville. Studies over a span of twenty-five years had not produced a method of strawboard waste treatment that would be used although each investigator had contributed information of value to those who later took up the study.

It is not known exactly when the lagoons at Noblesville were put into use but Krancher[7] sets the date at between forty and fifty years prior to 1951 which would make lagooning at Noblesville date back to around 1900. These lagoons were built as storage reservoirs with the idea in mind to keep the waste out of the stream.

Rue and Rawlings[8] in 1925 suggested the alleviation of stream pollution by changing methods of strawboard production, but there is no record to show that their process was extensively used. Present day changes in processing have been largely made to produce a better product, with the result that there is usually a greater amount of waste material.

After another considerable period Eldridge and Mallmann[9] reported in 1931 on the anaerobic digestion of sludge from strawboard wastes with sewage sludge. Their results were not encouraging in as much as the strawboard solids seemed to slow down digestion. These results discouraged those who might have considered treating strawboard wastes in combination with domestic sewage.

Talk on the need for methods for treatment of strawboard waste prompted Ladson and Ross[10] at Rose Polytechnic Institute, in Terre Haute, in 1939, to determine the quantity and

character of the waste from one of the mills in that city, and to try known methods of treatment for the disposal of the waste. These investigators tried aeration, chemical precipitation and activated sludge and reported that it required twenty-seven grains of filter alum to produce effective coagulation in a gallon of waste; other processes were no more promising. During the course of their work B. A. Poole, chief Engr. of the Indiana State Board of Health, had written them saying "at the present time, as we see it, the practical disposal of strawboard waste stands as a conspicuous engineering problem, difficult, but possible of solution."

In 1940 Hardman and Helsley, two other Rose Polytechnic men undertook further chemical precipitation studies. They used ferric chloride, ferric sulfate, alum and asbestos fibers. None of these materials were completely successful.

Purdue Studies

In 1945 the National Council for Stream Pollution of the Pulp, Paper and Paper Board Industries, Inc., instituted studies at Purdue University. In the investigation under this sponsorship, an extensive survey of the written material on strawboard and strawboard wastes was accomplished.

Mill Visits

An inspection" of ten straw mills revealed that although raw and finished products are approximately the same, there is considerable difference in the methods of processing the raw material. Different processing methods result in wastes that differ in concentration. It is believed now that the total waste waters from a strawmill contain essentially the same constituents varying only in concentration. This belief may later be proven to be inaccurate because of the wide variation in chemicals that are now or may be used.

Surveys of the mill wastes have brought out that, in general, they can be classified into three groups: (1) rotary, the most concentrated, (2) washer-beater, and (3) machine water, the least concentrated. Knowing this general fact makes the approach of a particular waste disposal problem less difficult to solve. As an illustration: If a stream can handle an appreciable quantity of waste with an oxygen requirement of approximately 200 ppm., it is reasonable to believe that Save-all equipment is sufficient to treat the machine water, and the treatment of the more concentrated waste to produce a similar oxygen requirement would, not only suffice, but would be the economical and reasonable procedure to follow.

Chemical Analysis

An investigation was made of the nitrogen, phosphoric acid and potash content of strawboard wastes to determine whether the waste provides a balanced food for the bacteria that will decompose the waste, either aerobically or anaerobically. This study revealed that on the basis of presently reported information the total waste may not contain sufficient nitrogen for optimum organism growth. Supplements of nitrogen in pilot plant operations, however, have not resulted in noticeable improvements in efficiencies of these units.

Mineral Analysis

Chemical analysis of the ash from the solids in the waste indicated that variations in the common elements may be appreciable. It is thought that these differences in mineral constituent concentration are due to mineral content of the water and the types and quantities of chemicals used in cooking. There has been no indication that the concentration of the commoner elements has any effect upon the processes of treatment studied.

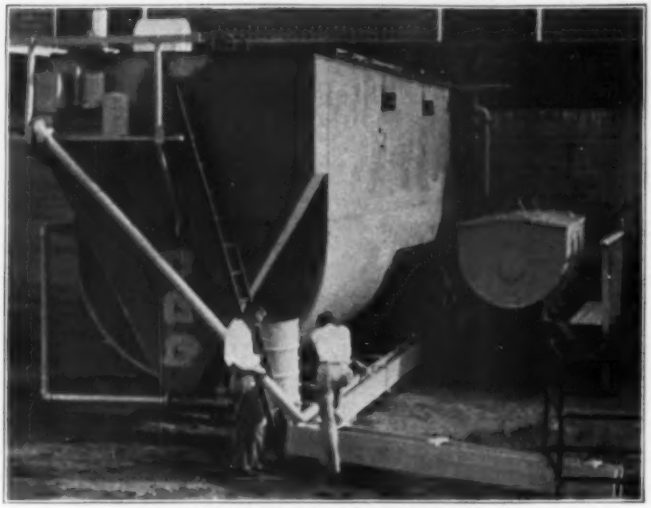
Some concern has arisen over the increase in use of chemicals containing sulfur but to date their use has not resulted in noticeable changes in mechanical or biological processes of treatment. It is appreciated that it is necessary for the industry to take advantage of all developments in processing that will benefit them but thought must also be given to the effect such changes may have upon the waste treatment processes contemplated or in use.

Analysis of Raw Material

Analysis of the wastes, measurements of waste flows and mill production figures for a two and one-half months period at one mill revealed that the solids in waste waters amount to thirty percent of the total raw materials going into the mill. From these data it was apparent that a large portion of the raw materials, used for straw paper manufacture, are not found in the final product.

Processing of a screened portion of a representative bale of straw in the laboratory brought out that only seventy-nine percent of the waste solids result from the production of ninety-five percent of the usable pulp. This means that twenty-one percent of the waste solids originate from the material that nets only five percent of the paper stock. Consideration of this fact should encourage the selection of

DIGESTION EXPERIMENTS on strawboard waste at Purdue University



HIGH RATE DIGESTER pilot plant at Weston Paper Co.

better raw material or the processing of the raw materials prior to water washing if waste water disposal costs are prohibitive.

Primary Settling

The large amount of solids present in the waste has prompted consideration of methods for removing them from waste waters. Because sedimentation is the most economical method of removing settleable solids, the determination of the effectiveness of sedimentation has been important. Data accumulated on the operation of two types of settling tanks has shown that seventeen percent of the total solids can be removed in any sedimentation tank operating at reasonable over-flow rates. The quantity of biochemical oxygen demand removed by sedimentation is in proportion to the total solids removed.

These studies are important where there is a question whether primary or complete treatment is necessary because they indicate the degree of treatment obtainable by sedimentation. The disposal of sludge obtained by primary treatment remains a problem. There is evidence from Eldridge's studies[9] and the observation of lagoon operation at Noblesville that there is material reduction of settleable solids by anaerobic means. The rate of digestion needs further investigation.

Primary sludge can be concentrated and treated with chemicals so that it can be dewatered on vacuum filters. The cost of chemicals is very high, probably due to the large quantity of lime used in processing. Changes in cooking practices with reduced quantities of lime may possibly reduce chemical costs so that in instances of necessity, filtration of sludge may be practiced.

Trickling Filter

The availability of a small trickling filter at the mill of the Weston Paper Co. at Terre Haute, Ind., made it quite simple to run tests[10] on treatment by trickling filter. Even with nitrogen supplements added to the waste it was impossible to maintain economic rates of application that would result in satisfactory effluents. At waste temperatures of approximately 80°F it was possible to remove approximately eighty percent of the B.O.D. This method of treatment requires a considerable investment in plant structures and is not effective in the colder months. Effluents obtained are about as strong as domestic sewage.

Anaerobic Digestion

The high concentrations of organic materials and the large volumes of waste waters coupled with the fact that secondary treatment by aerobic processes could not be made to handle more than present day sewage plant loadings prompted investigation of possible methods of treatment that could do the job in a more economical and, if possible, more effective manner.

Laboratory tests[12] had disclosed that rather rapid destruction of organic matter could be accomplished by anaerobic decomposition of those materials not removable by sedimentation. It has been found that washer-beater waste waters with an average B.O.D. of 2400 ppm., can be converted in four to ten days of anaerobic decomposition to yield effluents with

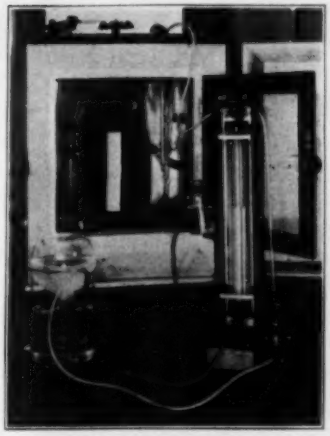
BATTERY OF DIGESTERS at strawboard mill in Holland.

between 160 and 500 ppm. B.O.D. The studies have been carried on at controlled temperatures to obtain information on loading per unit of digester volume. There is evidence that some mixing of incoming waste with seed sludge is essential for rapid decomposition.

It seems unlikely at the moment, however, that digestion tanks will be constructed because controlled lagooning has been found to accomplish excellent results during the warmer seasons of the year when stream conditions are critical.

Lagooning

Investigations of the operation of the lagoons at Noblesville (Ind.) Mill of Ball Brothers, so ably described by Krancher,[3] brought out that discharges from these basins, during the warmer months, had a B.O.D. comparable with good trickling filter effluent. It is believed that with controlled lagooning, the 5 day B.O.D. to most streams can be so reduced in quantity that reduction of dissolved oxygen in the stream will not be a problem.



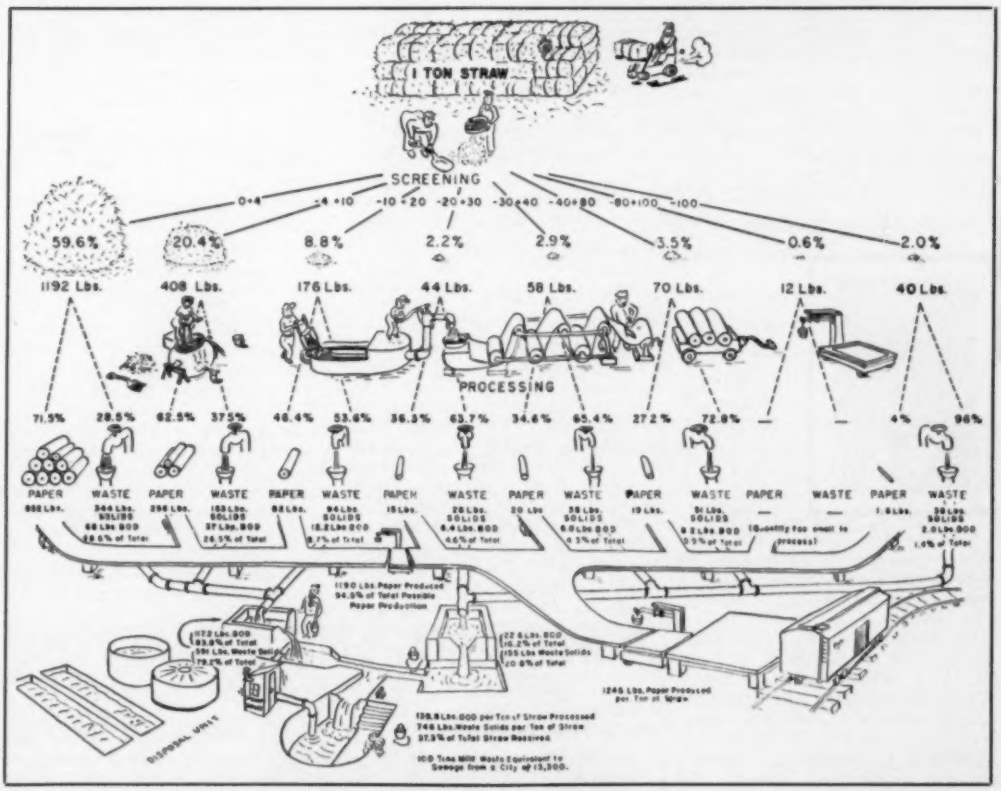
EXPERIMENTAL DIGESTER for strawboard waste studies at Purdue

During the cooler months when the lagoons are not producing an effluent with low B.O.D., the stream waters will also be cool and the rate of oxidation will be sufficiently slowed so that the rate of reaeration equals the rate of oxygen usage in the stream.

Although lagooning appeared effective as far as B.O.D. load on the stream was concerned, a surprising observation was made. The discharge of lagoon effluent into White River, source of part of the water used in Indianapolis, Ind. caused an increase in the amount of chemicals required for treatment of the water when lagoon effluent was detectable in the stream. An agreement was reached whereby one part of lagoon effluent could be discharged for every 350 parts of water flowing in the stream. This dilution was believed to be sufficient so that the amount of added chemicals required would be too small to detect.

When the Indianapolis Water Co. stated that the strawboard waste was responsible for excessive chemical demands, particularly chlorine demand, it was apparent that the chlorine was combining with substances other than those exhibiting a 5 day B.O.D.

Studies have shown that there is no relation between the B.O.D. of water containing strawboard wastes and the



STRAWBOARD vs. WASTE from one ton of processed straw

Drawn by Aubrey Strickland

amount of chemicals required to treat that water for human consumption. Thus appreciable removal of B.O.D. from the strawboard waste before discharge to a source of water supply does not reduce the chemicals required for treating the water for domestic use.

It is now believed that well operated lagoons will serve as a satisfactory means of treatment in a number of instances. The controlled lagoons at Noblesville, Ind., are meeting the present need. Lagoon construction would now be underway at the South Mill of the Weston Paper Co. at Terre Haute, Ind., if negotiations for the purchase of the necessary land could be completed. It seems quite likely that controlled lagooning for two Monroe, Mich. mills will meet the needs at that location as the major complaint is that of excessive decomposition of solids in the receiving stream.

Organic Constituents of Waste

After observing the unusual chlorine demand a study was undertaken to determine the organic constituents in the waste. It was found that appreciable amounts of pentosans, reducing sugars, volatile acids and proteins are present and that all of these substances have a B.O.D. whereas the relatively high percentage of lignin present does not exhibit a B.O.D. value. Lignin extracted from the waste has a chlorine demand of one part of chlorine for each part of lignin. This information should prompt further search for methods of straw processing that will decrease either the constituents exhibiting B.O.D., or the lignin, depending upon the desire or necessity for their elimination from the waste. These studies should go hand in hand with an investigation of the effects that the various organic substances will have upon the strawboard or straw paper should they be left in the finished products.

In the future it will be necessary to investigate the possibilities and effectiveness of aerobic processes for further (secondary) treatment of the effluents from the anaerobic processes. It will be advisable to carry out studies on primary sludge disposal and in this connection it will be essential to determine the rates of solids reduction by anaerobic digestion and the rates of vacuum filtration using heretofore untried chemical combinations and filtering equipment.

It is probable that the anaerobic pilot plant should be continued in operation in order to study the effectiveness and flexibility of the process in treating variations in characteristics of wastes resulting from manufacturing process changes and to try out ideas that may result in higher rates of treatment per unit plant volume.

Acknowledgments

Those who have given of their time and assistance in carrying out the National Council Studies are: R. L. Burns, C. G. Krancher, G. K. Erganian, D. E. Lynch, Jr., R. Cummings, J. C. Hargleroad, R. Eck, J. F. Kinneman, A. J. Horstmann, M. Lummis, R. D. Coleman, N. J. Lardieri, Aubrey Strickland.

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D. V. Moses Dies Suddenly

Dr. Douglas Verne Moses, technical supervisor, E. I. du Pont de Nemours plant at Belle, W. Va., died suddenly on April 30, 1951, victim of a heart attack.

Dr. Moses, a leader in the West Va. Section of A.W.W.A. and the W. Va. Sewage and Industrial Wastes Assn., of which he was chairman at the time of his sudden passing. Of A.W.W.A.'s W. Va. Section he was a past-chairman. He was also an active participant in the stream pollution abatement committee of the Manufacturer's Chemists Assn. to which he recently reported on a new scheme for catalytic oxidation of difficult organic wastes from the Belle, W. Va., plant. (See W.&S.W. for July 1951—page 309.) He was co-developer of this process, which is being adopted by his company.

Dr. Moses, a native of Iowa, and graduate of Iowa State College (B.S. in Chemical Engineering 1919 and Ph.D. 1925), has been technical supervisor of the du Pont plant at Belle, W. Va., since 1929 and in recent years had been placed in charge of the water supply and waste disposal undertakings at the Belle plant. Dr. Moses loss will be keenly felt by his company and the association with which he was connected in such an actively productive capacity.

Indianapolis Begins Water Fluoridation

On Aug. 8, the Indianapolis Water Co. began fluoridation of its water supply. This is, we believe, the largest private or publically owned water utility to undertake water fluoridation.

The introduction of fluoride is in agreement with a resolution adopted Mar. 23, 1951, by the Dept. of Pub. Health and Hospitals of the City of Indianapolis. It is also in accord with an order from the Public Service Commission of Indiana on May 18, 1951, which pertained primarily to the approval of a petition to increase the water rates for metered service, etc. The fluoridation program was also recommended and endorsed by the Indianapolis Medical Society and by the Indianapolis District Dental Society.

Sodium fluoride is the chemical used and enough is added to bring the fluoride content to 1.0 ppm. One source of supply, the White River, contains 0.2 ppm. fluoride, and the other, Fall River contains from 0.08 to 0.1 ppm.

As a part of its public relations program, the Indianapolis Water Co. ran newspaper advertisements on two successive Tuesdays before the treatment was started.

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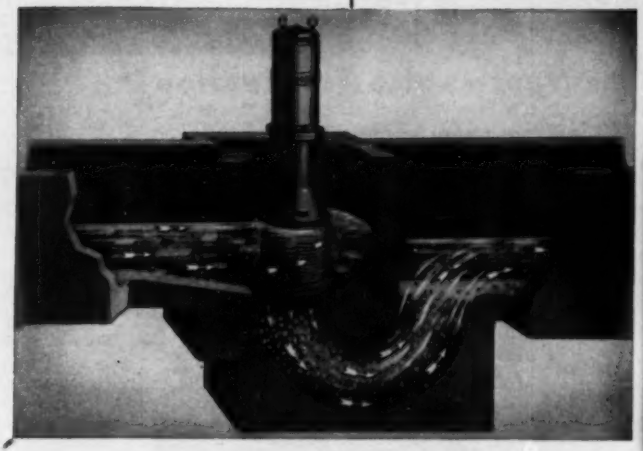
cut coarse sewage matter into small settleable solids without removal from channel



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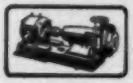

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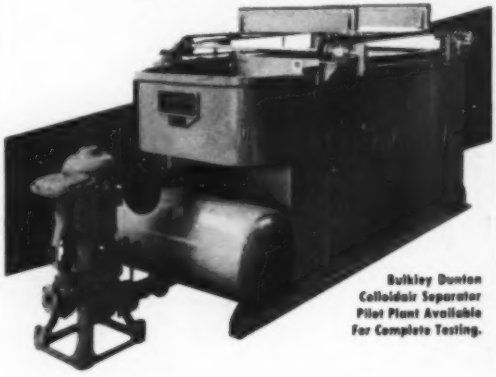

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Meetings Scheduled:

Sept. 10-12—Boston, Mass. *(Hotel Statler)* NEW ENGLAND WATER WORKS ASSOCIATION (Annual convention). Sec'y, Jos. C. Knox, 73 Trement Street, Boston 8, Mass.

Sept. 10-14—Chapel Hill, N.C. *(Univ. of North Carolina)* NORTH CAROLINA SEWAGE & INDUSTRIAL WASTES TREATMENT SCHOOL. Director, Emil T. Chanlett, Assoc. Prof. of Sanitary Engineering, Univ. of North Carolina, Chapel Hill, N.C.

Sept. 11-13—Marshalltown, Iowa *(Hotel Tall Corn)* IOWA SEWAGE WORKS ASSOCIATION. Sec'y. Leo Holtcamp, P.O. Box 310, Webster City, Ia.

Sept. 12-14—Minneapolis, Minn. *(Hotel Nicollet)* MINNESOTA SECTION A.W.W.A. Sec'y, Leonard N. Thompson, 216 Court House Bldg., St. Paul, Minn.

Sept. 13-14—Whiteface, N.Y. *(Whiteface Inn on Lake Placid)* NEW YORK SECTION A.W.W.A. Sec'y, Rollo K. Blanchard, 50 West 50th Street, New York 20, N.Y.

Sept. 16-19—Detroit, Mich. *(Veterans Memorial Bldg.)* AMERICAN PUBLIC WORKS ASSOCIATION. (Annual Convention). Director, D. F. Herrick, 1313 East 60th St., Chicago, Ill.

Sept. 17-19—Louisville, Ky. *(Kentucky Hotel)* KENTUCKY-TENNESSEE SECTION A.W.W.A. and KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSN. Sec'y R. P. Farrell, 420 Sixth Ave., N., Nashville 3, Tenn.

Sept. 19-21—Yankton, S. Dak. *(Charles Gurney Hotel)* MICHIGAN SECTION A.W.W.A. Sec'y T. L. Vander Velde, 2609 E. Saginaw Street, Lansing 12, Mich.

Sept. 19-21—Atlanta, Ga. *(Georgia Institute of Technology)* GEORGIA WATER & SEWAGE ASSOCIATION and GEORGIA WATER & SEWAGE SCHOOL. Sec'y, A. T. Storey, 1210 Hempkill Ave., N.W., Atlanta, Ga.

Sept. 19-21—Yankton, S. Dak *(Charles Gurney Hotel)* SOUTH DAKOTA SECTION A.W.W.A. and SOUTH DAKOTA SEWAGE WORKS ASSOCIATION. Sec'y, Chas. E. Carl, State Board of Health, Pierre, S. Dak.

Sept. 19-21—Philadelphia, Pa. *(Stratford Hotel)* PENNSYLVANIA SECTION A.W.W.A. Sec'y, L. S. Morgan, Dept. of Health, Greensburg, Pa.

Sept. 24-25—Denver Colo. *(Cosmopolitan Hotel)* ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, Geo. J. Turre, P.O. Box 600, Denver, Colo.

Sept. 26—Denver, Colo. *(Cosmopolitan Hotel)* ROCKY MOUNTAIN SEWAGE WORKS ASSOCIATION. Sec'y, Carrol H. Coberly, 1441 Welton St., Denver, Colo.

Sept. 24-26—Biloxi, Miss. *(Buena Vista Hotel)* ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, Chas. W. White, 519 Dexter Ave., Montgomery, Ala.

Sept. 25-27—Milwaukee, Wis. *(Hotel Pfister)* WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison 3, Wis.

Sept. 26-28—Fargo, N.D. *(Gardner Hotel)* NORTH DAKOTA WATER & SEWAGE WORKS CONFERENCE. Sec'y, Jerome H. Svore, State Dept. of Health, Bismarck, N.D.

Sept. 27-28—Saskatoon, Sask. *(Bessborough Hotel)* WESTERN CANADA WATER & SEWAGE CONFERENCE. Sec'y, H. C. Lindsten, 301 Hamilton Bldg., Winnipeg, Can.

Sept. 27-28—Toledo, Ohio *(Commodore Perry Hotel)* OHIO SECTION A.W.W.A. Sec'y, F. P. Fischer, 812 Perry Payne Bldg., Cleveland 13, Ohio.

Sept. 29—Livingston, N.J. *(Doerr's Grove)* NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION. (12th Annual Outing). Sec'y, Michael S. Kachorsky, P.O. Box 766, Manville, N.J.

Sept. 30-Oct. 2—St. Joseph, Mo. *(Robidoux Hotel)* MISSOURI SECTION A.W.W.A. MISSOURI WATER & SEWAGE CONFERENCE. Sec'y, Warren A. Kramer, State Office Bldg., Jefferson City, Mo.

Oct. 3-4—Charleston, W. Va. *(Daniel Boone Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Glen O. Fortney, State Health Department, Charleston, W. Va.

Oct. 4-5—Charleston, W. Va. *(Daniel Boone Hotel)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, H. K. Gidley, State Department of Health, Charleston 5, W. Va.

Oct. 8-11—St. Paul, Minn. *(Municipal Auditorium)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSN'S. (Annual Convention) W. H. Wisely, 325 Illinois Building, Champaign, Ill.

Oct. 14-17—Fort Worth Texas *(Hotel Texas)*
SOUTHWEST SECTION A.W.W.A. Sec'y, L. A. Jackson, Memorial Auditorium, Little Rock, Ark.

Oct. 18-20—Corpus Christi, Texas
NATIONAL ASSOCIATION OF CORROSION ENGINEERS. (South Central Region.) Sec'y, A. B. Campbell, 919 Milam Building, Houston, Tex.

Oct. 22-24—Pittsburgh, Pa. *(Hotel William Penn)*
THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. (12th Annual Water Conference). Sec'y W. M. Porter, Hotel William Penn, Pittsburgh 30, Pa.

Oct. 22-25—New York, N.Y.
AMERICAN SOCIETY OF CIVIL ENGINEERS. (Annual Meeting). Sec'y, William N. Carey, 33 West 39th St., New York 18, N.Y.

Oct. 23-26—Atlantic City, N.J. *(Hotel Claridge)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, W. A. Kufs, 510 Telegraph Bldg., Harrisburg, Pa.

Oct. 23-26—San Francisco, Calif. *(Fairmont Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, Wm. W. Aultman, Box 38, LaVerne, Calif.

Oct. 25-27—Dubuque, Iowa *(Hotel Julien)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

Oct. 25-27—Atlantic City, N.J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N.J.

Oct. 28-31—Daytona Beach, Fla. *(Sheraton Plaza Hotel)*
FLORIDA SECTION A.W.W.A. and
FLORIDA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Perry M. Teeple, P.O. Box 210, Jacksonville, Fla.

Oct. 29-Nov. 2—San Francisco, Calif. *(Civic Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION. (Annual Meeting) Sec'y, Mrs. W. R. Walsh, 1790 Broadway, New York, N.Y.

Oct. 31-Nov. 2—*Baltimore, Md. (Sheraton Belvedere Hotel)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl J. Lauter, 5902 Dalecarlia Place, N.W., Washington 16, D.C.

Nov. 6-7—Providence, R.I. *(Sheraton Biltmore Hotel)*
NEW ENGLAND SEWAGE WORKS ASSOCIATION. Sec'y, Walter E. Merrill, 511-A State House, Boston, Mass.

Nov. 7-9—Roanoke, Va. *(Hotel Roanoke)*
VIRGINIA SECTION A.W.W.A. Sec'y, W. H. Shewbridge, 708 State Office Bldg., Richmond 19, Va.

Nov. 12-14—Winston-Salem, N.C. *(Robert E. Lee Hotel)*
NORTH CAROLINA SECTION A.W.W.A. and
NORTH CAROLINA SEWAGE & INDUSTRIAL WASTES ASSN. Sec'y, E. C. Hubbard, State Board of Health, Raleigh, N.C.

Dec. 3-7—Stillwater, Okla. *(Oklahoma A. & M.)*
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Dec. 10-14—Stillwater, Okla. *(Oklahoma A. & M.)*
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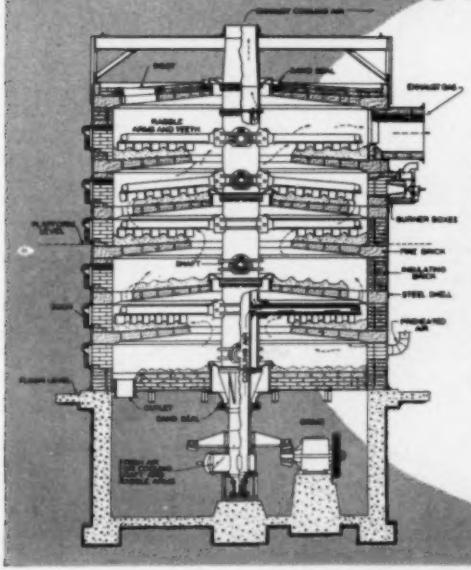
by Nichols



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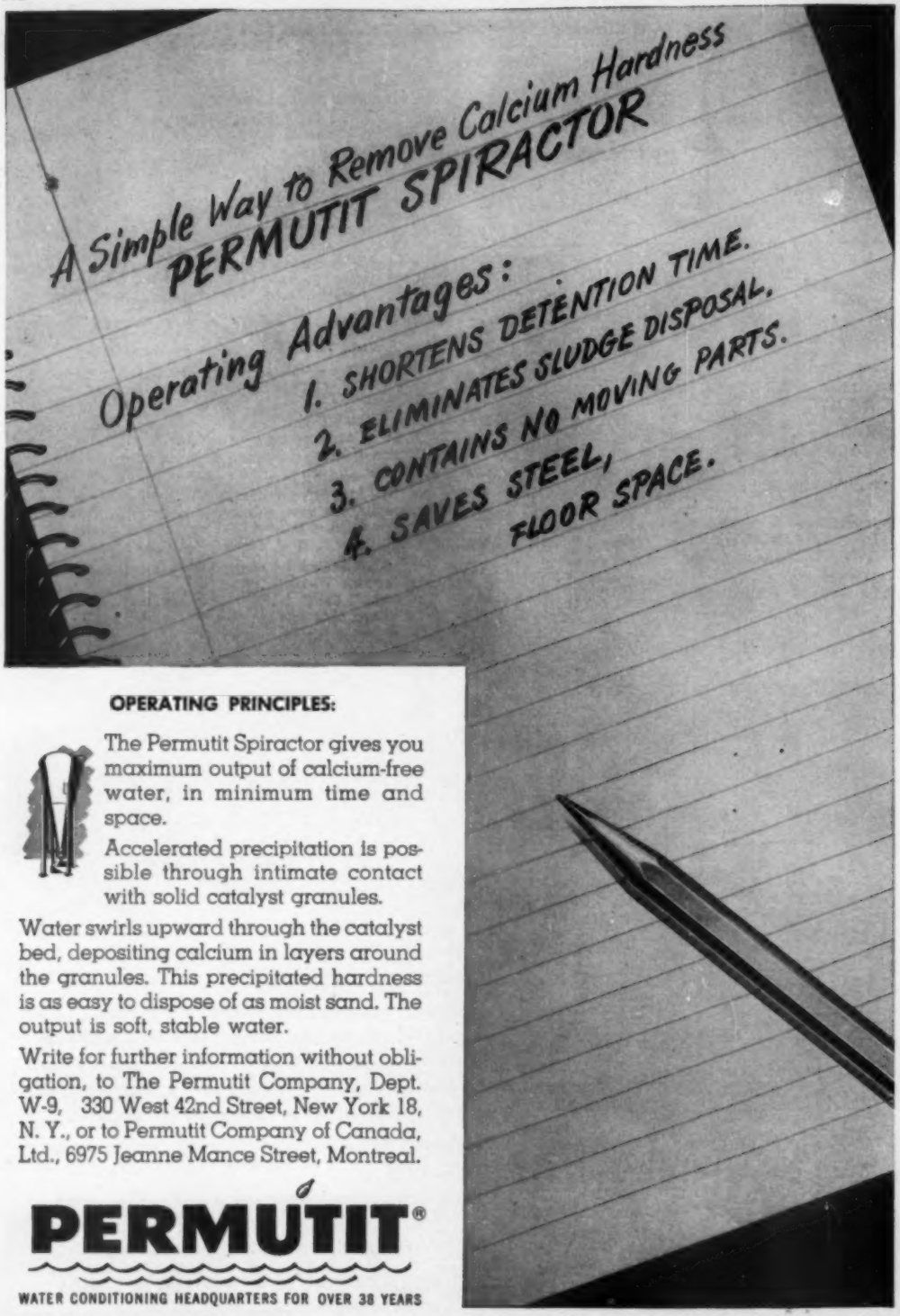
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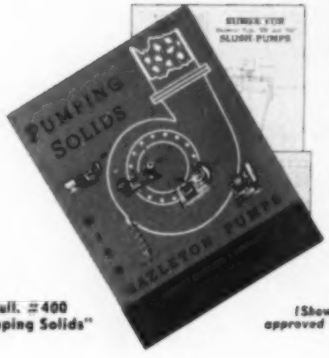

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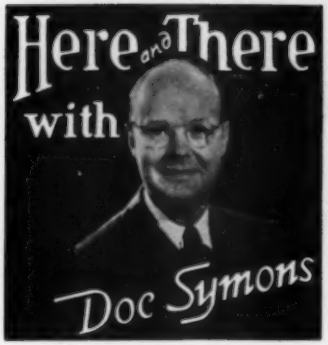

Here's **T**hat **M**an **A**gain—And this month, not only am I going to continue the story of the Miami AWWA Convention, but I've got some news for you.—Now to return to the Miami Meeting, and from the looks of the pile of notes I have, this will spill over into the next issue.

* * *

If you read the official story of the convention, beginning in the June issue of *Water & Sewage Works*, you know that both the exhibits and the sessions were held in the Dinner Key Convention Hall—And right now I want to express my thanks to the AWWA office crew for all of the help they gave me. That includes Harry (Mr. Water Works, Himself) Jordan, Ray Faust (Mr. W.W. Jr.), Rick Johnson, Dan Fischel and, of course, Mary Rodgers and Lois Schultz.—Also thanks to John Stewart and "Dottie" Dimmers of the Manufacturers Assn.

* * *

Wandering around the exhibit floor, I ran into "Dick" (Cons. Engr.) Hazen talking with A. A. (Tony) Kalinske of Infilco. "Tony" was telling Dick about Infilco's new location in Tucson, Ariz., where they bought property, formerly a Catholic orphanage. Quick on the uptake, Dick said, "And I presume that you will keep the chapel, where you can go each morning to pray that your competitors go broke."

* * *

Walter Peirce, Mgr., Water Dept., Racine, Wis., stopped me to point out that many of the papers at the convention were the result of tabulating replies to questionnaires. Walt thinks we should have another word for questionnaire. He also thinks I had one in my column a few years back, when I wrote something about the Upper Mississippi River Basin Engineers.—Does anyone remember what it was?

(Continued on page 100A)

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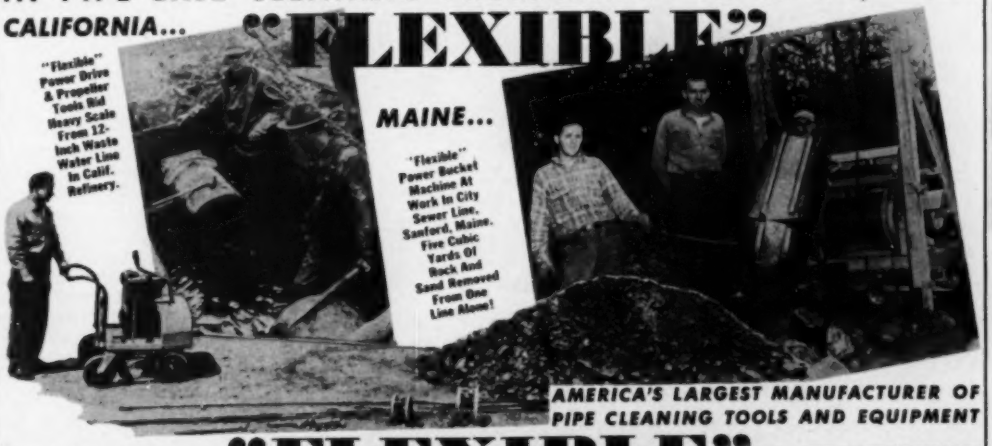
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AMERICA'S LARGEST MANUFACTURER OF PIPE CLEANING TOOLS AND EQUIPMENT

"FLEXIBLE"

UNDERGROUND PIPE CLEANING CO. **SEWER-ROD EQUIPMENT CO.**
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29 Cordan Ave., Roslindale 31, Mass.
801 East Excelsior Blvd., Hopkins, Minn.
3786 Durango St., Los Angeles 34, Calif.
4455 S. E. 24th St., Portland, Oregon
351 West Jefferson Blvd., Room 614, Dallas, Texas

(Continued from page 98A)

I guess Col. "Bill" Hardenbergh (*Public Works Mag.*) had the w.k. last laugh.—On the floor plan of the exhibit hall, the AWWA registration desk was in the front foyer, the exhibit hall behind, and *Public Works'* booth was on the back aisle.—So what happens?—All the taxis and all the cars pulled up at the back door (which was left open for ventilation) and there sat "Bill" Hardenbergh, saying hello to every one who came to the convention.—How lucky can you get?

* * *

I queried John (Greenville, S.C.) Hawkins as to why he dropped out as an officer of the Water Works Management Division. "Just too darn busy at Greenville," replied Johnny.—Too bad—The W.W.M.D. lost a good man, there.

* * *

Not all was "heavy stuff" at the technical sessions; a good laugh cropped up every now and then, as when Paul (Atlanta W.W. Gen. Mgr.) Weir reported that their F-M radio code was K.I.C.—300. "Keep It Clean," said Paul.

And Lou (Indianapolis Wat. Co. V.P. & Ch. Engr.) Finch said he used the Bell Telephone System, but it had its disadvantages. Once he had to wait until two other fellows finished a "long-winded and dry" conversation about the weather which at the time was neither "long-winded nor dry." Lou says, too, that his men often speak in two languages, American and profane—the latter frequently being subject to being cut off the air.

And that famed comedian from Akron, Ohio, Wendell La Due (past president of AWWA and distinguished member of the Society of Council Bluffers) brought down the house with the story of why all the mules are from Missouri and the Swedes from Minnesota.—Missouri had first choice, according to Wendell.

* * *

I'm sure every one knew that when the AWWA hired Ray Faust as Exec. Asst. Secy., they got a powerhouse. How powerful was evident at Miami when Ray was waxing enthusiastic about Safety and blew a tube in the loud speaker system. What Ray was saying was that the AWWA should have an active Safety Program.—Makes sense, doesn't he?

* * *

Wm. F. Guyton, Consulting Ground Water Geologist, had me running to the "Glossary of Water and Sewage Control Engineering Terms" when he mentioned phreatophyte several times.—"Phreatophyte—A plant that habitually obtains its water supply from the zone of saturation, either directly or through the capillary fringe."—So that's what he was talking about?

* * *

I never did hear what happened in the competition for the new AWWA seal. There were some pretty good ones, too, among the sixty odd drawings submitted, but many of them had too much detail to make good reproductions in small size. Maybe I should ask Rick (AWWA Ed.) Johnson, who won the contest.

* * *

Wisconsin AWWA Beanie Club.—At least three members showed up at the convention with their beanies—Art (Kenosha) Kuranz, Francis (Neptune Meter) Cunningham, and V.T.Y. Where were the rest of you?

* * *

The manufacturers' luncheon was a huge success as usual. Edgar (*American City*) Buttenheim got a cup for 23 years service as Treasurer; Pres. "Bob" ("Transite" Pipe) Orth reported that six 1950 conventions with exhibits, drew more than 5000 persons to see 256 exhibits put on by 194 members of the association.

Speaker at the luncheon was a fellow named Lovejoy, a Marketing Executive for Socony-Vacuum Oil Co. He chided our industry for poor mar-

keting, asking why we paint pipe a wonderful black and why we make hydrants with no sex appeal, etc.—Have you an answer?

* * *

One morning at the Everglades Hotel, I sat down at the counter and found my neighbor was L. R. Simonton, from Griffin, Ga.—He's a D.P.B.—Dual Personality Boy. He supervises both the water and sewage works. Extra personality runs in the family, I decided, when I met Mrs. Simonton.

* * *

One couple I sorely missed at this meeting, Ed and Zita Alt; he of the Chicago Bridge and Iron Co., she of the beautiful hair and—everything. On hand, though were a couple of old pals; Frank (Electro Rust Proofing) and Myra McDonald. Frank was Golfing Master, if not Master Golfer.

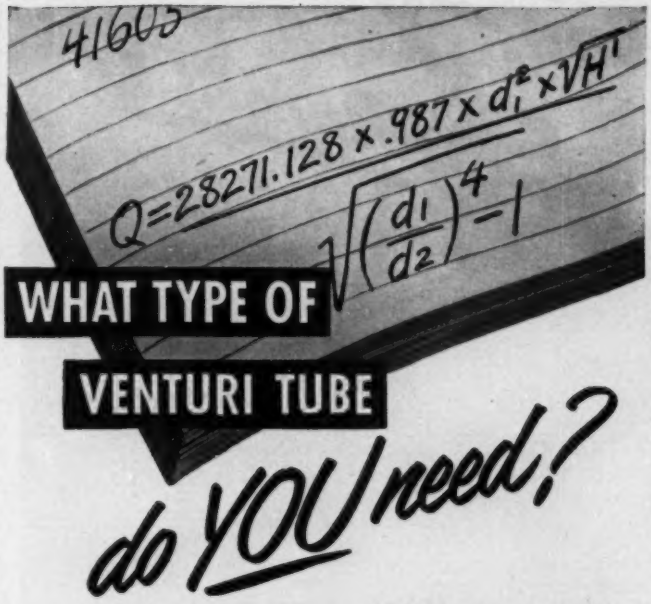
* * *

It looks as though this story is going to "spill way over" into the next issue. I have yet to tell you about the golf prizes and my part in them, about the cocktail parties, the annual dinner dance, the meeting of the Society of Council Bluffers, our trip to Key West, my impressions of Lake Worth and the trip home. But all that can wait until the October issue. Right now, I've something else to tell you.

* * *

If you haven't already read the item in the main section of this issue of *Water & Sewage Works*—here's news for you.—This is the last issue in which the Masthead on page 5 will carry my name as Managing Editor. After several years of planning, I am establishing an independent consulting service, specializing in technical consultation and free lance editing and writing in the sanitary engineering field. Technical services will include consultation on plant and laboratory design, research, and operation of water, sewage, and industrial waste treatment. In my free lance editorial and writing efforts, I shall serve as Contributing Editor to *Water & Sewage Works;* I shall also continue as Editor of *The Courier* of B-I-F Industries (Builders-Providence, Inc., Omega Machine Co., and Proportioneers, Inc.) I shall also be available for both technical and editorial services to equipment manufacturers and other magazines.—And now that the advertising plug is finished—

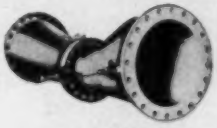
Oh yes—The "powers that be" on this magazine have asked me to continue writing my "Here and There" column, and I shall.—So it looks as though this 97th letter to you won't



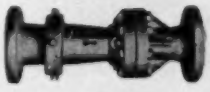
WHAT TYPE OF VENTURI TUBE do YOU need?

1. Steel plate tube with cast iron throat section for measurement of clear water, air or gases.

2. Cast iron Venturi Tube with hand holes and cleaning valves at main and throat sections, for municipal sewage and trade wastes.



3. Cast iron Venturi Tube with flat invert and single cleaning valve at main and throat sections. Specifically used for sludge.



4. Cast steel or cast iron Venturi for hot or cold water and adaptable for boiler feed high pressure service.

IT'S SIMPLEX IT'S ACCURATE

SIMPLEX makes Venturi Tubes for measuring cold water, raw sewage, trade waste, sludge, process liquor, boiler feed, air and gases.

These tubes come in many sizes and different designs, some of which are pictured above. This means there's a particular tube to fit specific needs.

Write, stating your Venturi Tube requirements, to Simplex Valve & Meter Company, Dept. 9,6743 Upland Street, Philadelphia 42, Pa.

SIMPLEX

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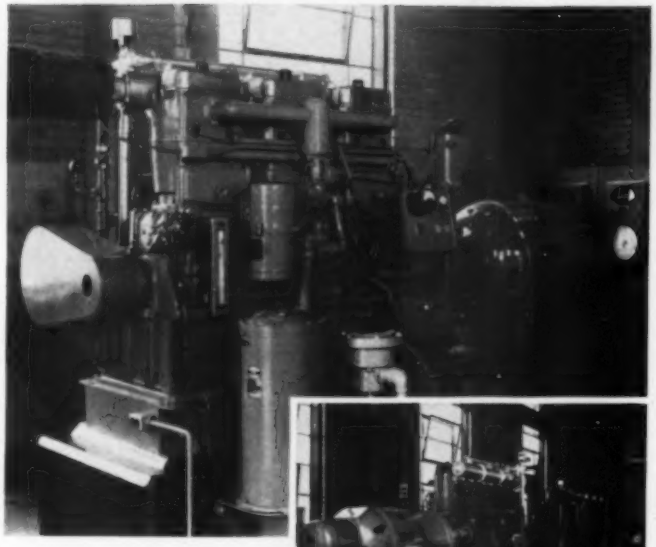

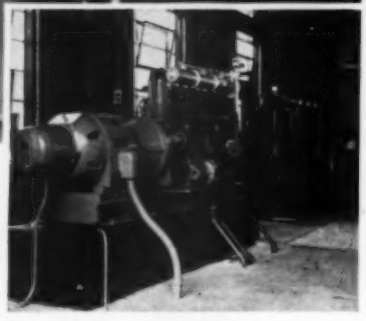

Two 90 H.P. Climax Blue Streak Sewage Gas Engines Direct Connected to 60 KW Generators for Operation in Parallel.

Leads

climax IN SEWAGE GAS ENGINE INSTALLATIONS

Proof of Climax quality products is that these engines are installed in hundreds of sewage treatment plants. Some of these engines have been in continuous service over 15 years, with a minimum of operating and maintenance expense. Sewage gas engines are available in sizes from 40 to 250 H.P. Gas, gasoline or Butane engines for emergency use are available in sizes up to 600 H.P.

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Write to . . . Climax Engine & Pump Mfg. Co. 208 S. La Salle Street, Chicago, Illinois

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Chicago - Dallas - Long Beach, Cal.

be my last. And I'll also be doing some reporting of meetings for *Wat. & Sew. Wks.* So on occasion I'll be seeing you "Here and There" and "Around The Country."

Well, that's MY news—What's yours?

V.T.Y.—Doc.

Diameters of Steel Cables* and Wire Rope

How to measure such diameters correctly

If you use a steel cable, and if for one reason or another you should be called upon to give its correct diameter, would you know how to measure it?

Offhand it might seem like a simple thing, and it *is* simple, but there is a *right* way and a *wrong* way, as shown in the accompanying sketches.

The correct diameter of a wire rope is the so-called diameter of a "circumscribed circle." That is, draw a circle that will *completely* enclose all of the strands and make that circle as small as possible without cutting through any of the strands. That is a "circumscribed circle" and it explains why the sketch marked "Right" is the correct method. A circle of the diameter marked "Wrong" would cut through the outer strands. If skeptical, try it yourself with a pair of compasses or dividers.

*Contributed by W. F. Schaphorst, M.E., Newark, N.J.

Conferences on Water Resources

To Dedicate Water Resources Building of Illinois State Water Survey Division.

The Illinois State Water Survey Division at Urbana, Ill., will hold a Conference on Water Resources on Oct. 1-3, 1951 and will dedicate the new Water Resources Building, on the University of Illinois Campus.

The program will consist of three concurrent sessions; one on Hydrology, one on Treatment, and one on Radar-Weather. The first named will

be held in the Illini Union Bldg., the second will be held in the University Chemistry Bldg., and the last named will be held at the Allerton Estate in Monticello, Ill.

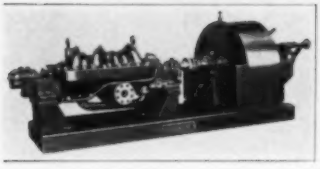
The objectives of the conference are the better understanding of the development and use of fundamentals in water resources, design and planning and the orienting of the collection of basic information.

The dedication of the new Water Resources Bldg. will be held at a banquet in the Ballroom of the Illini Union on Tuesday evening, Oct. 2.

"Oil and Water"

When it was learned that Mr. Harriman was being sent to Iran to try to smooth out the oil difficulties someone was heard to say—"Interesting job Harriman's got—that of *pouring water on the troubled oil.*"

Manufacturers & Equipment News



"Oppeller" Pumps

901

De Laval Steam Turbine Co., Trenton, New Jersey, has announced a new line of De Laval multi-stage opposed impeller pumps that are designed for general medium pressure and temperature service up to approximately 1000 gpm and 1200 psi.

The De Laval "Oppeller" pump has a horizontally split casing with suction and discharge nozzles on opposite sides of the lower half of the casing. Impellers are mounted back to back to balance axial thrust and the volutes are staggered 180° to balance radial thrust.

Bolted in stuffing box provides a means of applying a plain box with

You Get Longer Service, Less Maintenance, Greater All-Around Dependability with

GOLDEN-ANDERSON

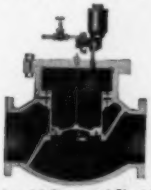
Cushioned

Steam and Water Pressure Valves

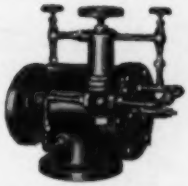
One of these eight valves will ideally meet your requirements

Single-Acting Non-Return Valve

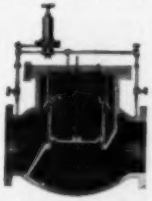
Altitude Control Valve



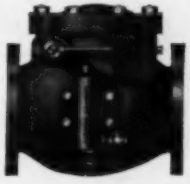
Solenoid Operated Electric Water Service Valve



Surge Relief Valve



Water Pressure Reducing Valve



Swing Check Valve

Cold Water Float Valve

Triple-Acting Non-Return Valve

Our descriptive bulletins covering these various valves gladly sent on request.

GOLDEN ANDERSON *Valve Specialty Company*

2075 KEENAN BUILDING • PITTSBURGH 22, PA.

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

STOP WATER SEEPAGE
SEWAGE CORROSION

WITH FORMULA No. 640

a clear liquid penetrating (1"+) sealer for concrete and masonry preventing water absorption and reducing the action of acids. Holds 12' hydrostatic head. Use our Hayproc Rubberized Enamel for color on walls and floors—not affected by concentrated acids, alcohol, oil, or traffic abrasion.

30 OTHER PRODUCTS
Write for technical data.

Haynes Products Co., Omaha 3, Nebr.
See our file in Sweet's

"Since 1885"

Sewage and Garbage Shredders

Detailed Specifications and suggested Installation Drawings furnished

GRUENDLER
CRUSHER & PULVERIZER CO.
ST. LOUIS 6, MO.

lantern ring for suction lifts; a water cooled box for high temperatures and high suction pressures; conventional or special, single or double mechanical seals or a breakdown bushing and leak-off arrangement.

Geo. Borst Wearing C. B & I. 25 Yr. Service Emblem

George E. Borst, manager of Chicago, Bridge & Iron Co's. Philadelphia office, is now wearing his company's 25-year service emblem, thereby becoming a member of C.B.&I's Quarter Century Club.

George is a native of Oelwein, Iowa, but spent his youth in Alabama and Florida. He attended the University of Chicago and joined Chicago, Bridge & Iron in 1925. He was transferred to the New York office and established the Philadelphia office as manager in 1927.

George is a member of the Am. Water Works Assn., the A.P.I., the A.W.S. and the Engineer's Club of Philadelphia. With a son 21 yrs. old, a daughter 19 and another 17, George doesn't look his age, as the accompanying picture will testify.

Harco Offering Cathodic Protection

Harco Corporation, Cleveland, Ohio, has announced the extension of its services to include the complete engineering, design and installation of cathodic protection devices which will substantially increase the working life of underground pipe lines, water storage tanks, lead sheather cable, flocculators, clarifiers, etc.

In a Harco installation for water storage tanks, alternating current from the nearest outlet is converted to direct current by means of a transformer-rectifier unit and sent to anodes mounted inside the water tank or tower. The current radiates from the anodes in all directions, using water as the electrolyte, to every portion of the underwater steel surface in such magnitude as to oppose electrochemical action and corrosion.

All Harco installations utilize especially designed oil-immersed selenium

(*Continued on page* 105A)

You're burying your money's worth . . .

when you specify
WARREN
CAST IRON PIPE

"Built To Be Forgotten"

You can be **sure** you get 100 cents to the dollar when you plan your piping system around **WARREN** Cast Iron Pipe and **WARREN** Cast Iron Fittings.

WARREN Cast Iron Pipe is produced in all sizes from 2" to 84" with all types of joints . . . fittings in numerous non-standard patterns to meet unusual requirements.

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55 LIBERTY STREET, NEW YORK 5, N. Y.
Bell & Spigot Pipe • Flange Pipe • Mechanical Joint Pipe
Flexible Joint Pipe • Short Body Bell & Spigot Specials
WARREN PIPE CO. OF MASS. INC. 75 FEDERAL ST. BOSTON, MASS.

STRENGTH...TOUGHNESS
RESILIENCY...MEAN
MAXIMUM LIFE!

95 Years of Continuous Service

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READER SERVICE CARDS HOW TO USE THEM

Please fill out a separate coupon for each item on which you desire information. This will greatly facilitate handling.

Key number is at head of each new product, item of equipment, catalog or bulletin, described in this issue.

Enter key number in box.

Please PRINT your name and title, company or department name, and your address

NOTE—

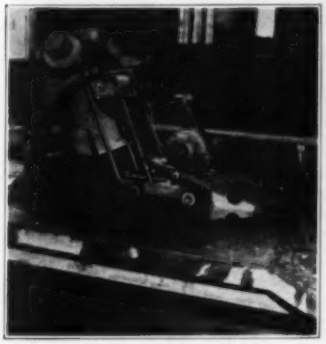
These cards are to be used only for items described in THIS ISSUE

WATER & SEWAGE WORKS

Will see that you receive information desired.

(*Continued from page* 104A)

rectifiers and ground anodes and backfill materials manufactured specifically for these applications. Anodes of graphite, carbon, zinc, magnesium, platinum, aluminum, steel or steel alloys are specified according to the requirements of each installation.



Clipper Concrete Saw

902

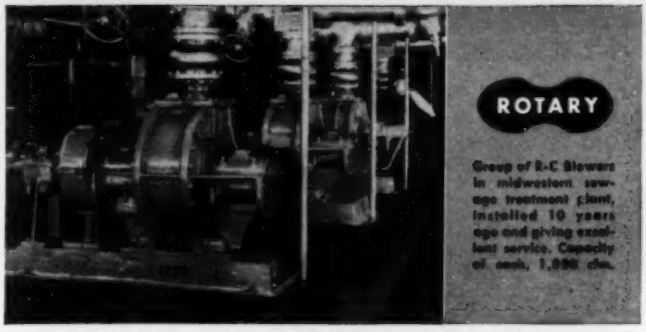
Clipper Manufacturing Co., Kansas City, Mo., announced that the new electrically powered Model C-20 Clipper Concrete Saw was used in the new Washington, D.C., Dalecarlia Filtration Plant. Faced with the problem of "trimming" completely through the 4½ inch concrete slab, the Clipper Concrete Saw was selected and handled the job at a cutting speed of 1 lineal foot per minute 1 inch deep. Clipper's new Diamond Blade was used and it sawed an average of 585 lineal inch feet per blade. The contractor stated that the Clipper saw produced perfectly smooth edges and an estimated saving of $4000 on the job.

The Clipper Concrete Saw was also used recently to cut a trench 150 feet long and 3 feet wide in the concrete floor of Macy's Basement to allow the replacement of a broken water main. The trench was cut in the floor in the midst of merchandise display counters.

Chlorine Production Expansion by Pittsburgh Plate Glass

Pittsburgh Plate Glass Co., Pittsburgh, Pa., reports that construction is under way on an $8,500,000 expansion of Chlorine production facilities at Natrium, W. Va. The new plant is to be operated by Southern Alkali Corp., subsidiary of Pittsburgh Plate Glass Co., when it is ready to go into service in the late

NO V-P-L WORRIES WITH R-C BLOWERS

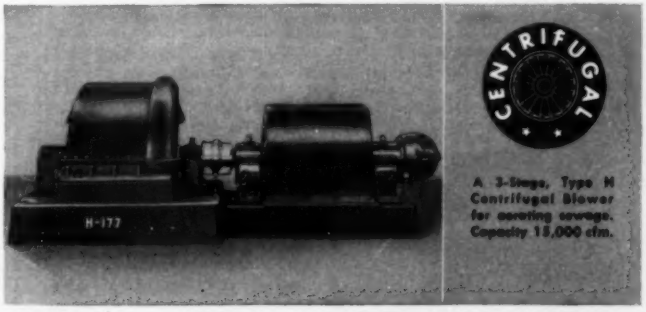

ROTARY
Group of R-C Blowers in midwestern sewage treatment plant, installed 10 years ago and giving excellent service. Capacity of each, 1,000 cfm.

Continuous separation processes in modern sewage treatment depend upon adequate performance of blowers. You can be sure of positive Volume, at the required Pressure and at Low power cost when Roots-Connersville Blowers move the air.

You can obtain this freedom from worry by selecting either R-C Centrifugal or Rotary Positive equipment from our exclusive *dual-ability line.* For large municipal plants, R-C units deliver up to 100,000 cfm. For industrial waste treatment, using small blowers, we supply Rotary Positive units with volume as low as 5 cfm. This wide latitude permits use of blowers closely matched to demand, with resultant economy in first cost and in power consumption.

The services of R-C engineers are always available to help select the best equipment for the sewage treatment job to be done.

ROOTS-CONNERSVILLE BLOWER CORPORATION
510 Mount Avenue, Connersville, Indiana



ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1848
ONE OF THE DRESSER INDUSTRIES

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

fall of 1952. For this needed additional chlorine production the Defense Production Administration issued a certificate of necessity.

Pneumatic Sewage Ejectors

903

Ralph B. Carter Co., Hackensack, New Jersey, has available their Eject-O-Matic, Model BE Sewage Ejectors. These units, developed as a solution to small capacity pumping problems, contain no moving parts, cannot clog, and have the ability to pass solid material the same size as the suction inlet.

Construction features include receivers or "pots" of cast iron, or copper bearing electrically welded steel; working pressures guaranteed up to 50 pounds; bronze mounted check and gate valves as well as rotary type air compressors; two metal electrodes, which eliminate the necessity of floats, float rods or other moving parts inside the receiver. When installed and operating there is no accumulation of solids and no accumulation of gas.

M & H Mechanical Joint
IBBM AWWA Gate Valve

Purchase price (or first cost) of a valve is not its real cost. Maintenance engineers appraise the true cost of a valve as cost per year of service—i.e., purchase price plus maintenance costs divided by years in operation.

On that basis, M & H likes comparison because M & H Valves are designed to last longer and entail little or no maintenance cost. Sizes 2 to 30-inch, with all end connections, including Mechanical Joint as shown.

Installing M & H Mechanical-Joint Valves into an existing pipe line is easily and quickly done by common labor with Mechanical Joint Cutting-In Sleeves. The job of regular inspection and maintenance of fire hydrants is also greatly simplified if auxiliary valves are installed for each hydrant, and an M & H Mechanical-Joint Valve makes such a job an easy one.

MECHANICAL JOINT
CUTTING-IN SLEEVE

M & H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

M&H PRODUCTS Everywhere

Worthington Names Mumford

Worthington Pump and Machinery Corp. has announced the appointment of W. Clifford Mumford as Manager of the Vertical Turbine Pump Sales Division.

Mr. Mumford joined Worthington in 1938 at the Holyoke, Mass. Works, and advanced successively from positions in the machine shops and erection department to the Vertical Turbine Pump Sales Division. Since 1946 he was assistant to the late Frank Kemp, and has been Acting Manager of the division since Mr. Kemp's death.

Fenmore E. Dunn, formerly Consulting Sales Engineer, has been named Assistant Manager of the Vertical Turbine Pump Division. Mr. Dunn has been associated with Worthington since June, 1950. He graduated from the Unuiversity of Cincinnati in 1950, with a B.S.M.E. degree. He was formerly Chief Engineer of the A. D. Cook Co., of Lawrenceburg, Ind.

Miniature Indicators and Control Units

904

Bailey Meter Company, Cleveland, Ohio, has developed a new line of miniature indicators and control units. These instruments offered under the trade name "Mini-Line" make it practical to concentrate into a small space before a single operator all information and controls.

Space savings are considerable. A new Multi-Point Indicator uses 87% less space than its standard size counterpart. A Selector Valve uses 52% less space, and a Remote Manual Relay uses 70% less space.

It is planned to mount "Mini-Line" instruments on console type centralized control panels whenever possible. These panels will be more than 50% smaller than any previously available. Control from a centralized "Mini-Line" Control Panel may be entirely automatic, or if the operator wishes, individual units or the entire system may be controlled manually from relays at his finger tips.

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

Borchardt Made V.P. by Worthington

Worthington Pump and Machinery Corp., Harrison, N.J., has announced the election of A. H. Borchardt to Vice President.

Mr. Borchardt will have the overall responsibility for the sale of the corporation's entire line of pumping equipment, including centrifugal, reciprocating and vertical turbine pumps.

Mr. Borchardt was graduated from Columbia University with a Mechanical Engineering degree. After graduating, he joined Worthington's erecting and testing department. He became successively draftsman, field engineer and sales engineer. In 1921 he was made assistant manager of Centrifugal Pump Sales, becoming it manager in 1929. He then became successively sales manager of the Harrison plant, manager of the Commercial Engineering Department and in 1934 Assistant Vice President and Manager of Centrifugal Pump Application and Sales Division.

Resilient-Base Capacitor Motors

905

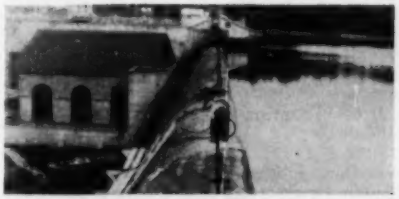
General Electric, Schenectady, N.Y., is now offering the Tri-Clad line of single-phase, capacitor, induction motors with a resilient-base construction.

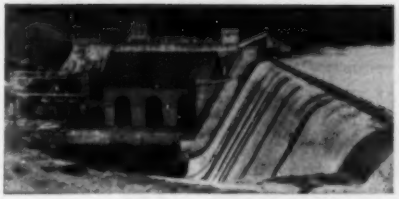
For use where freedom from vibration and extra-quiet operation are required, the construction is available on motors rated from ½ to 5 horsepower.

According to G-E engineers, all single-phase motors have some torque pulsation, but the resilient base isolates this vibration so that it is not transmitted to the driven machine.

Dynamically balanced for smooth operation, the Tri-Clad motor offers triple protection against physical damage, electrical breakdown, and operating wear and tear. Of cast iron construction, it features a totally-enclosed built-in transfer switch to keep foreign matter from the contacts, and a centrifugal mechanism designed for long life.

CEMENT GUN CO. RESTORES DAM WITH "GUNITE"





The photographs, at left, show a large Ambursen type dam in Northern New England which has been reintegrated with "GUNITE."

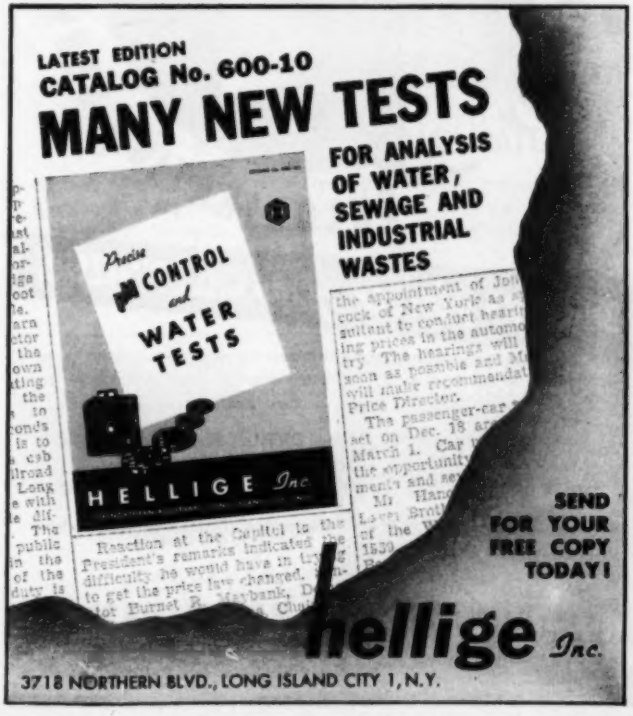
The top photograph shows the spalled and eroded condition of the concrete when the Cement Gun Company crews arrived on the job. The surface was chipped back to sound concrete and reinforcing mesh applied. Then the entire downstream surface was blanketed with "GUNITE."

The bottom photograph shows the completed "GUNITE" surfacing of the dam.

This is typical of many dams which we have restored throughout the country.

Many similar examples of repair, remodeling and new construction with "GUNITE" are described and pictured in Bulletin C2400. A request on your letterhead will bring a free copy by return mail.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA. U.S.A.
MANUFACTURERS OF THE CEMENT GUN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Sixty Year Man, Starr, Feted by Robinson Clay Products

Robinson Clay Products Co., Akron, Ohio recently feted John J. Starr, second vice president, with a colorful "surprise party" to celebrate his 60th anniversary with the firm.

The company's entire office personnel, headed by W. E. Robinson, president, paused to honor and congratulate the 84 year old veteran employee, whose service with the firm dates back to 1891, when he joined the Whitmore-Robinsons & Co., one of the companies merged into the present Robinson Clay Products Co.

The occasion was highlighted by the presentation of a "pin award," a large replica of a 60 year diamond pin attractively mounted on an easel stand. The presentation was made by President Robinson.

"Autotrator" for Automatic Titration

906

Coleman Instruments, Inc., Maywood, Ill., has developed a new "Autotrator," Model 19, that provides precise, high speed, fully automatic titration at minimum cost, and with the least possible uses of space or time.

The "Autotrator" performs automatically all the steps necessary to a perfect titrating technique. Titrant is delivered rapidly until the end-point approaches, then is restricted, the final portions being added in progressively smaller increments until the true end-point is reached. Operation is controlled by the Coleman Model 18 pH Electrometer which measures and continuously indicates the progress of the titration.

The "Autotrator" is designed to meet actual laboratory needs. It is realistically priced, employs standard laboratory accessories and occupies a minimum of laboratory space.

BUILDERS *visible flow* CHLORINIZERS

Builders Chlorinizers are available in these three volumetric models to control and meter chlorine gas in solution — for manual, program, semi-automatic, or flow proportional operation.

Up to 400 lbs./day . . . Model DV5X . . . Bulletin 840-F2A
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For Bulletins, address Builders-Providence, Inc. (Division of Builders Iron Foundry), 350 Harris Ave., Providence 1, R. I.

BUILDERS PROVIDENCE
Instruments

Allis-Chalmers Opens Atlanta Branch Building

Allis-Chalmers, Milwaukee, Wis., has announced the opening of a new, streamlined factory branch at 4646 Peachtree Boulevard, Atlanta, Georgia.

The new 8-acre property is described as the last word in modern and efficient methods for servicing A-C dealers. It is designed for the use of fork lift trucks, and a conveyor system speeds the packaging of repair parts. The modern, one-story structure has 60,000 square feet of floor space, plus 8,000 square feet of docks for trucks and rail shipments. Also included is 2 acres of outside paved and fenced area for parking and special machinery handling.

Brown Instruments Adds To Staff

Brown Instruments Division of Minneapolis - Honeywell Regulator Co., Philadelphia, Pa., has increased their engineering staff by 40%.

Because of shortages of engineering manpower, 30 colleges, universities and technical schools were personally combed in a recruiting campaign conducted by Brown executives. As a result, the company reported, 103 additional engineers have been taken on to meet expanding business.

Each new engineer is being given an intensive training course which includes orientation in the company's

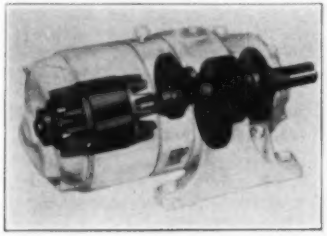
If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

organization, in production of new and improved existing process instruments.

Worthington's Water Treatment Section Moves

Sales and engineering functions of the Water Treating Section of Worthington Pump and Machinery Corporation were moved from the company's Dunellen, New Jersey plant to its Harrison, New Jersey, plant.

The engineering function for the Water Treating Section will continue under the charge of J. F. Sebald and the sales function under A. L. Jones.



New Twin Pinion Syncrogear Motor

907

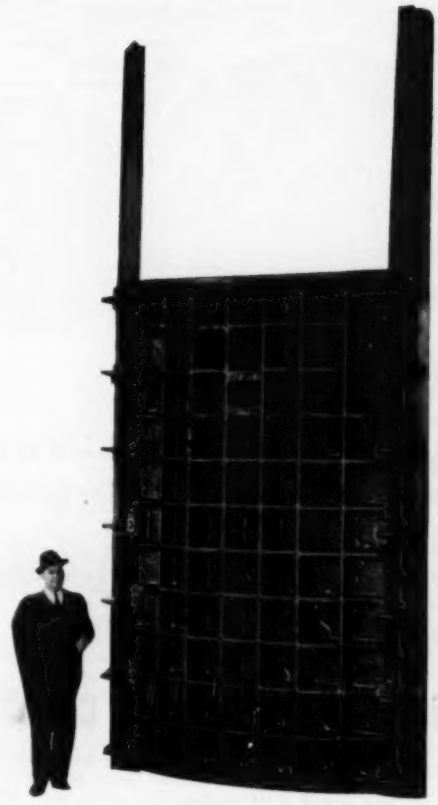
U.S. Electrical Motors, Inc., Los Angeles, Calif., has developed a brand new principle in geared motors in their Type GL Syncrogear Motor.

By using two secondary pinions to drive the output gear, U.S. engineers have doubled the effective torque rating of a conventional single pinion and gear unit. Incorporating the use of a splined herringbone pinion to equaly divide the load between the two secondary pinions, the Type GL Syncrogear produces high torque at low speeds while occupying only a fraction of of space required of a conventional drive.

Available with ratings of 5 to 25 hp, and with speeds from 30 to 84 rpm, the Type GL has the advanced features of asbestos-protected windings, normalized castings, solid "centricast" rotors and "lubriflush" lubrication.

Conoflow Increase Field Service

Conoflow Corporation, Philadelphia, Pa., has announced the extension of the company's field service to embrace Houston, Texas and Pittsburgh, Pennsylvania Territories. Mr. John C. Koch, Vice President, stated that Conoflow has recently expanded its



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are built to stand long trouble free service. Amply proportioned for all stresses of shipment, erection and operation. They may be obtained with manual, hydraulic cylinder or motor operating controls.

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LABORATORY MIXER

IS the important piece of equipment in the Modern Water Works Laboratory. Now being used by leaders in water works research. Many superintendents and chemists have been able to reduce their chemical costs by the control of chemical dosages with this mixer. Write for literature.

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Trade Mark Reg. U. S. Patent Office

A Filter Medium For All Purposes

ANTHRACITE EQUIPMENT CORP.

Anthracite Institute Building
Wilkes-Barre, Pa.

All correspondence regarding sales and engineering should be addressed to

PALMER FILTER EQUIPMENT CO.

822 E. 8th St. Erie, Pa.

Engineers and Sales Agents

activities to service many government contracts essential to national defense, in addition to filling the vital needs of private industry.

Already well-known in the trade, the Harold G. Jones Co., 502 Empire Building, Penna., has been appointed manufacturer's representatives serving Pittsburgh, western Penna., and northwestern West Virginia.

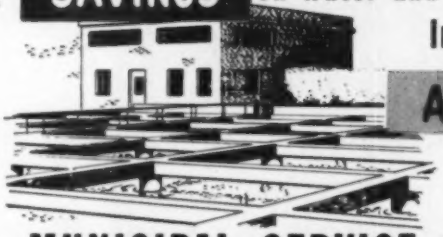
M. N. Aitken Company will represent Conoflow in Houston and the surrounding trading area extending from Freeport to Lake Charles, Louisiana. The Aitken Company is located at 5960 Kansas Street in in Houston.

Builders & Omega Appoint Langhammer

Builders - Providence, Inc., and Omega Machine Co., divisions of B-I-F Industries, Providence, R. I., have announced the appointment of E. G. Langhammer, San Antonio, Texas, as representative for the sale of their equipment.

Mr. Langhammer, President of the Texas Filter Co., will also continue to represent Proportioneers, Inc., another division of B-I-F Industries. The territory covered in this overall representation is that served out of San Antonio.

GREATER SAVINGS on Water and Sewage Plant Installations ASSURED



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Municipal Service Company specialists can relieve you of complicated technical details involved in the mechanical portion of your project. Our experience is your assurance of a successful plant installation. Write or wire today for details.

You're sure of greater savings when you contract with Municipal Service Company to furnish and install mechanical equipment and piping for your new municipal sewage or water plant. Municipal Service Company is a specialized organization of experienced engineers and skilled craftsman operating on a nation-wide basis.

The great volume of sewage and water plant equipment furnished and installed by Municipal Service Company is your assurance of greater savings... and more efficient production. Mechanical equipment installed has proved dependability for trouble-free, long life operation!

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Dept. M4—908 Grand Ave., Kansas City, Mo.
Chicago office: 205 West Wacker Drive

Automatic Ring Packing

908

Johns-Manville, New York, N.Y., has developed a new automatic ring packing "Uneepac." It is molded packing and each ring is a complete, self-contained packing unit.

Uneepac is designed for maximum sealing efficiency in minimum packing depth. No follower or header rings are needed and each ring centers itself perfectly on the preceding ring. In service, each lip is always exposed to fluid pressure. This provides instantly responsive, positive sealing. Since "Uneepac" does not depend on gland pressure for sealing, friction is reduced and there is less wear on both rod and packing.

Furnished in sets of endless or split rings, Uneepac is available for shafts $\frac{5}{8}$ inch diameter and up.

Dearborn Moves to Merchandise Mart

Dearborn Chemical Co., Chicago, Ill., has moved into new and modern air-conditioned offices in the Chicago Merchandise Mart.

President Robert A. Carr announced that the expansion, brought about through increased business and the need for extended customer service, will add an additional 5,000 square feet of office space. The new office, to be located on the third floor of the Mart, will also house Dearborn's Plumite Division, the company's household drain cleaner, and Electro-Chemical Engineering Corp., Dearborn subsidiary.

Mathematical Tables

909

Lefax Publishers, Philadelphia, Pa., has announced a newly revised loose leaf data book containing Mathematical Tables and Formulae needed to solve problems in arithmetic, geometry, algebra, trigonometry, analytical geometry and calculus.

The material is conveniently arranged in 6 thumb-indexed sections for ready reference. Sections are: Mathematical Reviews; Squares, Cubes, Square Roots, Cube Roots, Reciprocals, Areas and Circumferences, etc.; Five-Place Logarithms of Numbers; Five-Place Logarithms of Trigonometric Functions; Five-Place Natural Trig Functions; and Hyperbolic Functions. Consisting of 176 pages, with a 2 pin cover, the book sells for $1.50. A catalog giving over 2,000 listings of technical data books in convenient pocket size will be sent free by writing to Lefax Publishers, Philadelphia 7, Pa.

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

Schutte & Koerting Consolidate Facilities

Schutte and Koerting Company, Bucks County, Pa., on the occasion of their 75th anniversary, have announced the consolidation of General Offices and Manufacturing Facilities in one location in an enlarged modern plant at Cornwells Heights, Bucks County, Penna.

General Offices and some light manufacturing were formerly located at 12th and Thompson Streets, Philadelphia.

The new plant is located 20 miles Northeast of Philadelphia and 5 miles South of Bristol, Pa., on the banks of the Delaware River, convenient to the main line of the Pennsylvania Railroad.

Kittredge Joins Amer. Water Softener

American Water Softener Co., Philadelphia, Pa., has announced the appointment of Mr. Arthur E. Kittredge, well known mechanical engineer, to direct a newly formed division of the company. This division will develop the Deaeration Process for the removal of free oxygen and other gases from boiler feed water.

Mr. Kittredge recently concluded a long association with the Cochrane Corp., Philadelphia, as Vice President and Chief Engineer, and is widely known throughout the water treatment field, for his association with the development of the Deaeration Process.

Something New in Desk Calculators

910

Graphic Calculator Co., Chicago, Ill., has developed a new desk calculator for statisticians that gives results faster than an automatic computer or slide rule after only a few minutes of instruction.

Made of Vinylite plastic and based on principles of geometry, the calculator consists of a 10-inch disk which slides and rotates freely beneath a pair of vertical and horizontal scales

WABASH DOUBLE-LID COVERS

for MAXIMUM PROTECTION from frost

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The new No. 50 Ford Catalog contains full information. FREE. Send today.

The Wabash Cover was designed to provide the utmost in frost protection for pit water meters. Two lids, with a 4" dead air space between, add extra insulation. Notice also, the extra depth and the sloping skirt that help hold heat loss to a minimum.

Top lid is inset and locked with the patented Ford Lifter Worm Lock. There is no finer meter setting protection.

FOR BETTER WATER SERVICES — FORD

Manufactured by THE FORD METER BOX COMPANY, INC.

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STOP JOINT LEAKAGE USE CARSON CLAMPS

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SPEELMON ELEVATED TANK—SERVICE

COMPLETE PAINTING AND REPAIR SERVICE

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on which a series of right triangles is graphically formed. One simple mechanical operation of the calculator completes as many as five separate mathematical steps in about two seconds. Squares, sums of squares and square roots are all performed simultaneously and the calculator can be easily used in solving standard deviations, root-mean-squares, correlation coefficients, geometric and harmonic means, regression lines, etc.

Both linear and logarithmic scales are furnished with the calculator. Occupying a space 21 x 8 x 1 inches the complete set also contains a 14 page instruction manual and a needle-steel stylus.

Rust Constructing New Filters for Birmingham

The Rust Engineering Co., Birmingham, Ala., and Pittsburgh, Pa., has been authorized to construct the additions and alterations being made at the Shades Mountain Filter Plant of the Birmingham Water Works Co. at a cost of approximately $140,000.

Twelve new concrete filters, each with a capacity of one million gallons per day, are being added to the existing plant.

Besides the filter construction, Rust will make certain alterations and additions to the clear well and the existing filter buildings.

Ladder Stabilizer for Safety

911

Mine Safety Appliances Co., Pittsburgh, Pa., is now distributing a new ladder stabilizer that makes all kinds of ladders sure footed.

The "Hydra-Lizer" (hydraulic ladder-stabilizer) is an adjustable steel attachment for the lower end of straight or extension ladders. It provides safe footing for ladders in places where the two legs would not be on the same level, and can be used on any surface regardless of contour.

The assembly consists of two steel legs which act as plungers in vertical tubes attached to the lower ends of ladder rails. Each leg has a swiveled shoe, attached to its lower end by a ball and socket joint. The shoe, a hardened steel plate, has a rubber and cord sole 3/8 inch thick vulcanized to it.

The vertical tubes which house the legs or plungers are cross-connected near their upper ends by steel telescoping valve tubes leading to a central valve block. The valve assembly adjusts to any ladder width between 17 and 29 inches and fits straight, as well as flare base ladders. The entire assembly is filled with oil above the plungers. Opening the valve permits oil to move from one side of the system to the other. When one leg moves up to adjust itself automatically to a difference in level, the other leg moves down a corresponding distance. When the valve is closed, the system is locked so that neither leg can move further into its vertical tube.

PITT CHEM Tar Base Pipeline Enamel is a basic material of the tough, metal-preserving sheath that guards thousands of miles of America's greatest underground pipelines from corrosion. Dependable PITT CHEM coatings are being specified for more new lines each day because they're easier to apply and more dependable in service—the result of unvarying quality control made possible by our completely integrated operation.

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TENNESSEE CORPORATION

Literature & Catalogs

Automatic Control for Water Intake Traveling Screen

912

Foxboro Company, Foxboro, Mass., has available an Application Engineering Data Sheet on **Water Intake Traveling Screen Differential Level Control.**

The data sheet, complete with a line drawing, discusses the Automatic Traveling Screen Control with Trash Rack Signal that continuously records the differential levels across the traveling screen and trash rack. It further states that, when a predetermined differential level across the traveling screen is reached, the Controller automatically starts an electric timer to operate the screen drive motor and the high pressure spray pump. The timer insures sufficient duration to the cleaning cycle to carry the plugged portions of the screen past the high pressure sprays and the trash chute.

Cement Lining for Water Mains

913

Centriline Corporation, New York, N.Y., has made available a 4-page folder on the **Centriline Process** of lining water mains "in place" with cement.

The folder is profusely illustrated with photographs taken "on-the-job" and shows in detail all the operations concerned with lining the pipe. The process is described in detail—from scraping to finishing—and interesting data on relative carrying capacities of mains before and after Centriling are given.

Cement-Mortar Lining for Small Pipes

914

Centriline Corporation, New York, N. Y., has released a catalog on the **Tate Process,** covering cement-mortar lining of smaller diameter water, oil and gas pipe lines "in place".

The catalog describes the Tate Process, used for lining small diameter pipes from 4 inches upwards. Generally, pipes 16 inches in diameter and larger will be lined by the Centriline Process. Tate equipment consists of a regular steel scraper, which is followed by a rubber swabber to remove all loosened material and then the Tate liner that

FREE

to WATER WORKS and SEWAGE MEN

HOW TO CONTROL ALGAE

"The Use of Copper Sulphate in Control of Microscopic Organisms" by Dr. Frank E. Hale (former Director of Laboratories, Dept. of Water Supply, City of New York) is an authoritative work concerning the control of micro-organisms and elimination of tastes and odors. Describes in detail methods of controlling various forms of microscopic life commonly encountered in water supply systems. Contains descriptive material, plus 48 photo-micrograph studies of organisms discussed.

ROOT AND FUNGUS CONTROL

"Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains," by John W. Hood, contains information published for the first time. This material includes actual methods for control and operating procedure. Here's the book that is a "must" for all sewage men.

GET EITHER OR BOTH OF THESE BOOKLETS ABSOLUTELY FREE— These two valuable booklets, so important to all water works and sewage men, are yours *without obligation.* Mail coupon below!

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Please send my free copy of (check one or both):

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WS-951

The DRIVE
that assures you
continuous sewage service

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Right Angle
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HEALTH PROTECTION . . . Dependable for continuous 24 hour constant service.

AVAILABLE . . . Manufactured in sizes, types and ratios to meet varied applications.

DEPENDABILITY . . . High efficiency and all-weather service. Low operating cost.

WORLD WIDE ACCEPTANCE . . . In recognition of dependable service, economy of operation and maintenance. Hundreds now in use by municipalities.

INVESTIGATE NOW . . . Get the facts on the Johnson Right Angle Gear Drive. Send for illustrated catalog.

PHOTO: Type 3 — automatic dry pit municipal sewage installation at Stratford, Connecticut—electric motor or engine drive.

JOHNSON GEAR
AND MANUFACTURING CO.
"45 years of Engineering Service"
8th & Parker Streets • Berkeley 10, Calif.

squeezes cement mortar onto pipe walls, making a smooth, continuous lining of proper thickness.

Illustrated with photographs and cut-away diagrams, the catalog shows all the equipment used as well as actual photographs of pipe sections before and after lining.

Jointing Compound

915

Atlas Mineral Products Company, Mertztown, Pa., has just published a new bulletin on **Tegul-Mineralead,** the plasticized hot melt sulfur compound joint for bell and spigot cast iron water pipe.

The bulletin discusses the advantages of Tegul-Mineralead along with complete directions for using the compound, melting of the compound, yarning of pipe and the pouring of the molten Tegul-Mineralead.

A complete series of drawings show in detail all the operations in completing a Tegul-Mineralead joint. Quantities of Tegul-Mineralead needed for different diameter pipe are compared with the pounds of lead required for the same joint in a chart on the back page of the bulletin.

Surface Wash Systems and Walking Beam Flocculators

916

Stuart Corporation, Baltimore, Md., has just published a bulletin on **Filter Plant Equipment for Modern Water Treatment.**

The bulletin, enclosed in a 9 x 11½ inch file folder, is divided into two sections. Section I contains detailed prints and photos of the Palmer Surface Wash Systems. This section discusses all the operation and engineering details of the **Palmer Filter Bed Agitators.** Photographs and line drawings show the Agitator in use in many types of

WATER PLANT MANAGER

With adequate technical background and experience in water plant management including administration, operation, maintenance, accounting, public relations and improvement planning to assume without indoctrination immediate and full supervision of water plant in Northeastern State for a privately-owned, progressive utility. Salary Open. Box 1068, Water & Sewage Works, 22 W. Maple St., Chicago 10, Ill.

THE LEOPOLD GLAZED FIRE CLAY TILE FILTER BOTTOM

Check These Features!

• Low loss of head • Adaptable to any rectangular unit • Practically non-absorbent • Resists acid, alkali solutions • Long life • Equal filtration, distribution • Proved superiority.

Write for details!

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2413 W. Carson St., Pittsburgh 4, Pa.

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

ROBERTS FILTER MFG. CO.
607 Columbia Ave.
Darby, Pa.

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

filters. The advantages claimed and a list of the various installations in the country now using Palmer Surface Wash Systems along with other types of equipment handled by Stuart Corp. complete this section of the bulletin.

Section II consists of photographs with short descriptive matter on a cross-section of installations of **Walking Beam Flocculation Equipment.**

Magnetic Drive and Regutron Control

917

Electric Machinery Mfg. Co., has just released a book that discusses **"Precision Speed Control with the Adjustable-Speed Magnetic Drive.**

This 32-page book is technical in scope, and contains complete information both on the Magnetic Drive and the new Magnetic Amplifier Regutron Speed Control. The technical information is clarified through the use of many charts, diagrams, and illustrations.

A fully illustrated section is also included which covers the applications of the Magnetic Drive and Regutron Control in Industry.

Multi-Plate Underdrain System

918

General Filter Company, Ames, Iowa, an affiliate of Layne & Bowler, has just released a new folder describing the **Layne Multi-plate Underdrain System.**

The folder describes how Multiplates channel the upflow horizontally when backwashing a water purifying plant, and that the baffle plates are made from stainless steel to exacting dimensions.

Amply illustrated with cutaway drawings and photographs a typical installation shows the even water distribution and non-clogging features of the Multi-Plate.

Multi-Pump Controls for Elevated Tanks

919

Automatic Control Company, St. Paul, Minn., has published a new bulletin on **Multi-Pump Mototrols.** Described as similar to the Autocon Mototrol for elevated tank systems using one pump, the Multi-Pump Mototrols are for elevated tank systems using two or more pumps.

Using the same Twin Bellows Desing, the bulletin states that the new controls provide pin point accuracy;

SPARLING MAIN-LINE METERS

for Your

MASTER RECORDS

Every man responsible for water service knows the hazard of *guessing.* It is not enough to know the *rated* capacity of a pump. What is it doing right now?

The instrument at left tells all — direct totalization — present rate of flow — a complete picture of up to 60 days' deliveries. It can be installed close to, or miles away from, the Sparling Direct Action Meter that controls it.

Sparling Meters are noted for their conservation of line pressure. Even the Compound Meters—shown below, with flow ranges as high as 1 to 125—show less head loss than ordinary meters. That is part of Sparling economy.

RECORDERS, 24-Hour

RECORDERS, 7-Day

RECORDERS, 60-Days

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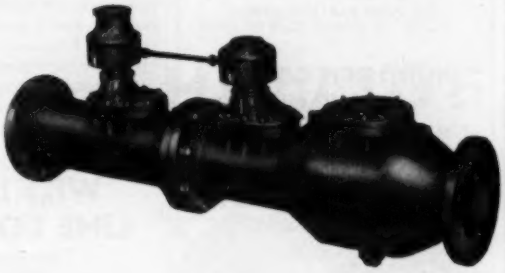
TOTALIZERS, Remote

BATCH CONTROLS

CONTROLS for Auto-Metered Chemical Feeds . . .



Quotations and Bulletin 311 come at your request

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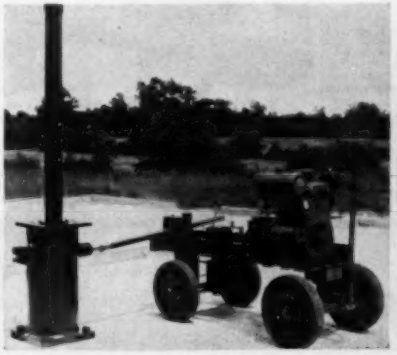

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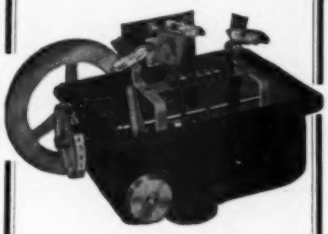

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14	2.5	7.00	2.25	24.02
16	2.5	8.25	2.25	33.07
18	2.5	9.25	2.25	36.88
20	2.5	10.50	2.25	40.71
24	2.5	13.00	2.50	53.02
30	2.75	16.00	2.50	65.36
36	2.75	19.00	2.50	77.96
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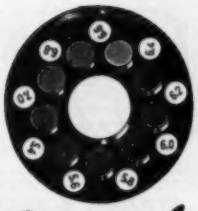

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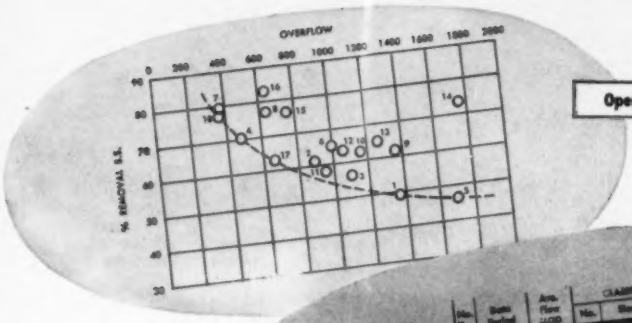

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radial flow—round or square units. Chart graphically illustrates results given in table below.

LOCATION	No. Units	Date Period	Area, Floor MGD	CLARIFIERS No.	CLARIFIERS Size	CLARIFIERS W.D.	Sol. Units	Overflow Gal.	SUSP. SOLIDS Raw	SUSP. SOLIDS Eff.	SUSP. SOLIDS % Rem.
1 Washington, Blue Plains Pl.	2	1944-45	136.2	12	100' Dia.	14	1.68	1360	163	88	49
2 Gary, Ind.	4	1941-44	30.11	4	75' Sq.	10	2.0	900	205	104	61
3 Winnipeg, Man.	2	1943-44	22.5	2	110' Dia.	12	1.90	1100	305	139	55
4 Battle Creek, Mich.	2	1930-42	4.93	2	80' Dia.	10	3.66	490	282	86	70
5 Buffalo, N. Y.	3	1939-41	136	3	140' "	15	1.4	1690	308	114	63
6 Albuquerque, N. M.	7	1939-40	8	1	80' "	12.3	2.51	990	334	91	84
7 Yakima, Wash.	1	1942	9.8	4	90' "	9	4.22	370	110	32	71
8 Appleton, Wis.	7	1938-42	4.8	2	70' "	10	2.09	683	370	85	77
9 Baltimore, Md.	4	1938-44	88.5	3	170' "	12	1.44	1340	214	85	61
10 Springfield, Ohio	4	1937-40	14.8	2	90' "	10	1.52	1160	146	65	63
11 Mansfield, Ohio	2	1944-45	3	1	60' "	12	2.28	980	208	97	58
12 Cedar Rapids, Ia.	9	1936-44	4.31	1	70' "	11.5	1.98	1000	304	132	65
13 Austin, Texas	2	1944-45	8.64	1	75' "	12	1.60	1275	263	98	64
14 Neenah-Menasha, Wis.	4	1942-43	7.98	2	70' "	10	1.8	1790	481	188	78
15 Denver, Colo.	2	1939-40	46	4	140' "	9.7	2.34	720	187	44	77
16 Sheboygan, Wis.	1	1944	6.4	1	90' "	10	2.2	632	342	68	80
17 Trufant, Mich.	3	1945-46	1.86	2	60' "	9	2.5	660	336	87	68
18 Monroe, Mich.	6	1938-46	4.3	2	80' "	7.8	3.20	370	387	78	77

check these facts

ON DORR SIFEED CLARIFIER PERFORMANCE

A few moments' study of this graph and the supporting table will give you a clear idea of what kind of performance you can expect Dorr Clarifiers to deliver.

These are long term records . . . obtained by competent plant chemists at well established installations. We believe they cannot be equaled.

Performance is one of the primary factors upon which Clarifier excellence should be judged. Are you getting the best?

We'd like to give you some figures on Dorr Clarifier repair costs too. Ask a Dorr engineer for the facts.

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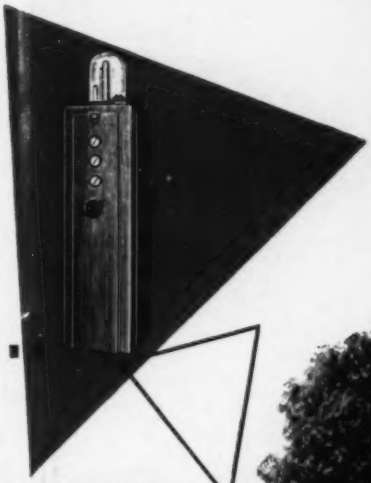
THE ROOTS DON'T SHOW.....



IN W & T CHLORINATORS, EITHER

The unseen roots of a beautiful tree give it life and strength. So, too, do the unseen features back of a W&T Chlorinator—technical assistance, basic research and service—ensure dependability and trouble-free operation throughout the years.

Basic research, for example, while not necessarily essential to each particular installation, is, nevertheless, the life blood of sound equipment. W&T research developed the visible vacuum principle, residual recording, the Break-Point Process and countless other advances in the art of chlorination.

This same research is constantly at work to help you solve your technical problems and to insure that the W&T equipment you buy is up-to-date in every respect and will not be outmoded before its time. The desire for that assurance may be another reason for the ever-growing demand for W&T Chlorinators.

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